States
ment of
Agriculture

Forest Service

Tongass
National
Forest
R10-MB-41c

Quartz Hill Molybdenum Project Mine Development

Final Environmental Impact Statement

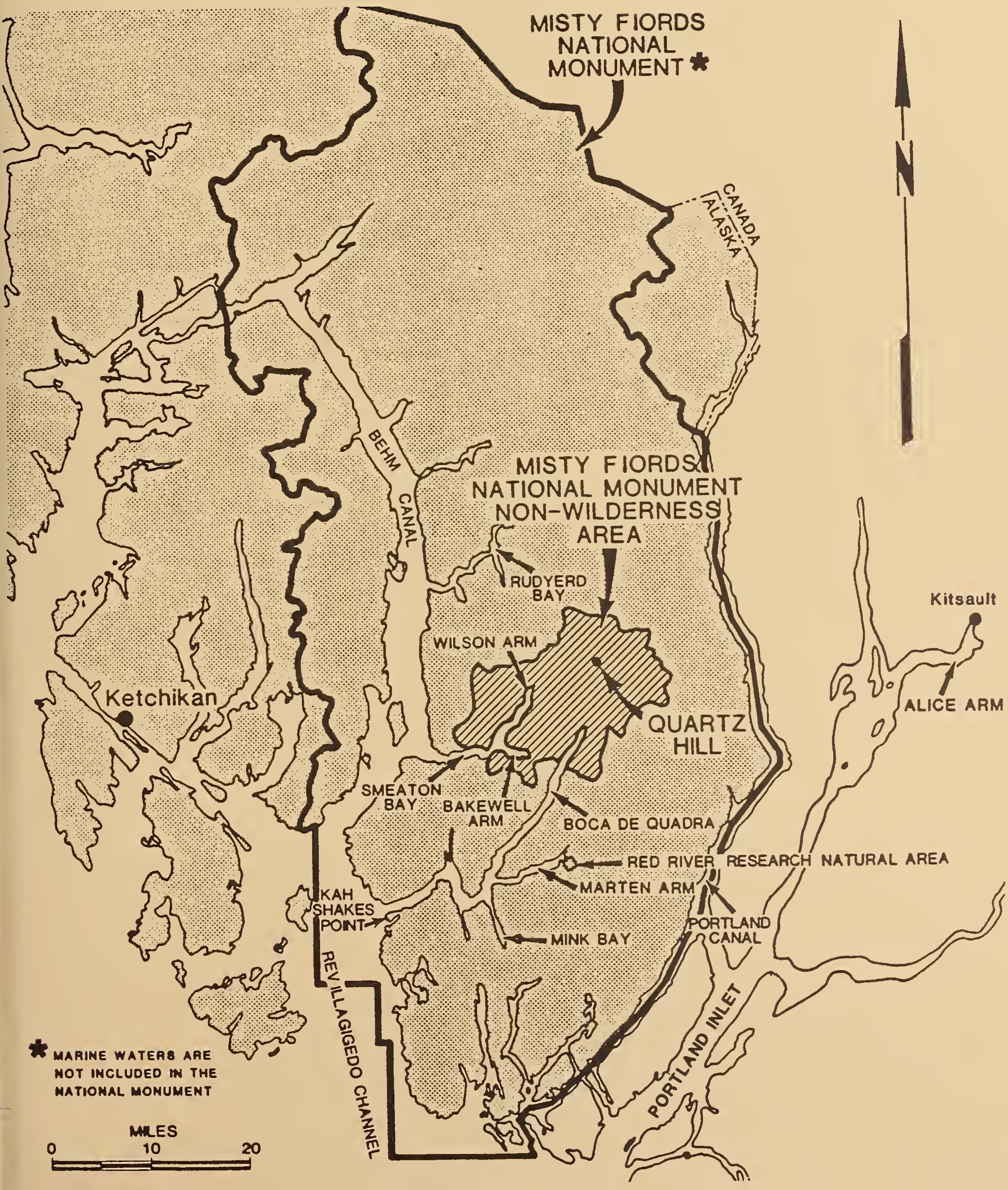
Comments and Responses

VOLUME 3

QUARTZ HILL MOLYBDENUM MINE DEVELOPMENT
FINAL ENVIRONMENTAL IMPACT STATEMENT

LIST OF APPENDICES

APPENDIX Q
COMMENT LETTERS



APPENDIX Q
COMMENT LETTERS

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UNITED FINANCIAL CORP.
INSURANCE

P.O. Box 33422
JUNEAU, ALASKA 99803
(907) 586-2603

April 29, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: U.S. Borax - Quartz Hill Project

Dear Mr. Green:

This letter is to support U.S. Borax and the U.S. Forest Service preferred alternative for tailings disposal in Wilson Arm as compared to Boca de Quadra.

I think economic as well as environmental facors must be taken into consideration on decisions that are made concerning this project. We are in competition with a world market.

Sincerely,

David J. Moe

David J. Moe
President

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KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

2

Dan R. Ford
4629 Sawa Circle
Juneau, AK 99801

April 29, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Re: Quartz Hill Molybdenum Project

Dear Mr. Green:

I work for Bank of The North in Juneau and this morning heard the U.S. Borax people present their proposal for developing Quartz Hill. As a banker I have first hand knowledge of our economic problems and an idea of what some of those solutions could be. To me, development of our resources is key to our future.

#1 The purpose of this letter is to encourage the Forest Service and EPA to give stronger consideration to the economics of the Quartz Hill project. I encourage your consideration for protecting our environment but worry that stronger concern is given to that natural beauty than to the well being of our citizens. Please weigh those economic benefits before making those important decisions. Thank you.

Sincerely,

Dan R Ford

Dan R. Ford

cc: Mr. Robert Burd, EPA
Col. Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Office of the Governor

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3

SIDNEY S. ALDERMAN, JR.
MINING GEOLOGIST
909 HEARST BUILDING
5 THIRD STREET
SAN FRANCISCO, CALIFORNIA 94103
(415) 974-1190

April 30, 1987

Mr. Win Green
Forest Supervisor - USDA
Federal Building
Ketchikan, AK 99901

Re: QUARTZ HILL MOLYBDENUM PROJECT

Dear Mr. Green:

I am in favor of the Quartz Hill project and would like to express a supporting opinion.

I am well aware of the environmental problems associated with this project and others like it, but the real question is whether preservation is worth the economic and social cost.

The evolution of human society from neanderthal to the present has involved constant change, development, and growth, some of which, at times, has made a mess of parts of the earth and has infringed on other species. Nevertheless, we cannot have progress without a certain amount of disruption.

No thoughtful person could advocate stopping the development of society. But that is exactly what will happen if we become extreme in our desire to preserve the undeveloped portions of the earth's surface. We have to dig holes in the ground to build buildings, highways, and cities, bury garbage, lay pipelines, and grow crops. Mining projects are a necessary part of modern society, and you cannot have the raw materials to build our infrasturture and the energy to run everything without digging even bigger holes.

As a geologist, I know that the earth's crust heals itself very quickly. Man-made scars, and even the much larger scars created by nature such as the Mount St. Helens crater and devastation, will be filled-in, smoothed out and revegetated in short order, geologically speaking. The Quartz Hill Project is technically and economically sound, and the long run benefits to society will far outweigh the temporary damage to the environment.

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Sincerely,

Sidney S. Alderman, Jr.

cc: Mr. R. S. Burd - USEPA
Col. W. Gregory - USA COE
Mr. R. Grogan - Governor's office.

4

HOME
2760 DOUGLAS HIGHWAY
JUNEAU, ALASKA 99801

Waco Shelley
CONSULTANT
GOVERNMENT AND PUBLIC AFFAIRS
ALASKA

PHONE
HOME 364 2418
BUS 586 2119

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FOREST SUPERVISORS OFFICE

April 30, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

This will relate to the Quartz Hill Project E.I.S., but please permit this preface of my personal and professional background. I have been associated with Mobil Oil Corporation since 1936 with the period, December 30, 1970, to present as Alaska Representative in Government and Public Affairs. Retiring from Mobil in 1978, I have continued the activity as a consultant. These 50 years have given the unique perspective of having observed environmental concerns evolve from nil to today's level where E.I.S. reports are measured with yard-sticks.

Through close personal association with Don Finney, and as a Director of the Alaska State Chamber of Commerce since 1975, I have followed this project from its beginning. I am confident that it combines the mix of imagination, finance, engineering, technology and concern necessary to make it a viable development in an environmentally sensitive area.

#1

Now to the Wilson Arm and Boca de Quadra Fjords alternatives. The E.P.A. position that the latter is preferable becsuse it imposes "less risk" makes no consideration of incremental costs of each unit of "reduced risk" below the level that the U.S. Forest Service considers safe and acceptable. I will editorialize with this comment: The extent to which additional financial and human resources are expended to reach the utopian level inherent in the E.P.A. alternatives seems directly proportional to the drift toward infinity of the time targeted for some sort of return on the huge capital investment at risk here.

#2

Every project of this nature must be expected to compete economically in the commodities market place of a world that makes a more "realistic" than "idealistic" assessment of "risks" at issue here. Please let me urge that the tangible "benefits" of this project be subjected to the same scrutiny and evaluation as the intangible "risks". Then I will feel assured that the considered decision will concur with the U.S. Forest Service - Wilson Arm Selection.

Sincerely,

C. Waco Shelley

CWS:cbr

5

JOHN JORDAN COWIN
3705 WIMBLETON LANE
BIRMINGHAM, ALABAMA 35223

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May 1, 1987

Mr. Win Green
Forest Supervisor - Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Sir:

I am writing you concerning the Quartz Hill project presently under exploration by the United States Borax and Chemical Corporation. I strongly favor development of this ore deposit with the proper safeguards for the environment.

We in the "lower 48" must not allow Alaska to be locked up and its mineral wealth lost. The United States must remain as self sufficient in strategic mineral as possible, and Alaska is probably our best single remaining source of undeveloped mineral wealth.

I have friends living both in Anchorage and Juneau with whom I have discussed the development of Alaska, and more specifically the Quartz Hill project. They all favor development of Alaska and believe the economic well being of the State depends on development of resources such as Quartz Hill.

I urge you to approve the Quartz Hill project after examination of the environmental guards proposed.

Yours very truly,

John J Cowin

John J. Cowin

JJC:mw

cc: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr.Bob Grogan

6

EARL H. BEISTLINE
Mine Consultant

P.O. Box 80148
Fairbanks, Alaska 99708
(907) 479-6240

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May 1, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

Essential to a strong Alaska economy (jobs and state income), is the development of Alaska's natural resources such as forestry, agriculture, fisheries and minerals (energy minerals, metallics and non metallics). Diversification in resource development is essential to prevent major recessions often caused by basing our economy on only one such resource as oil and gas at present.

U.S. Borax Quartz Hill Molybdenum Project is a major brilliant north star that can shine brightly in Alaska'a and the Nation's economic future. Therefore, every reasonable assistance should be given to U.S. Borax by involved state and federal agencies to make the Quartz Hill project a viable operation.

Based on consideration of overall pertinent factors, research and reports done in recent years, it is apparent that disposal of tailings in Wilson Arm/Smeaton Bay is more desirable than in Boca de Quadra middle basin. Specifically, in my mind, this is based on proposed sound environmental control, nearly negligible commercial fish loss and a much less capital and operating cost for utilization of Wilson Arm/Smeaton Bay. Such a large additional cost for utilization of Boca de Quadra works toward haulting a major mining operation that, in turn, means loss of potential jobs and income to the State.

The forgoing thoughts are based on my being a life-long Alaskan, raised in Juneau and for many years a resident of Interior Alaska. My profession has been a mining engineer and I am retired from the University of Alaska-Fairbanks after being on the mining faculty for about 36 years. During this lifetime, I am well aware of the 1930-32 depression and how Alaska cities were not as severely affected as other cities in the Nation because of resource industries. A large portion of such development was the major mining activities in the Territory at the time (Alaska Juneau Gold Mining Company; Kennicott Copper Corporation (Cordova); United States Smelting, Refining and Mining Company at Fairbanks and Nome; Matanuska Coal fields and Willow Creek Gold Mines, Palmer and Anchorage service centers; Healy River Coal Mines; and numerous small-scale, family mines in many parts of Alaska.)

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Mr. Win Green
May 1, 1987
Page 2

Consequently, I am in complete support of the Quartz Hill Project because I fully believe that it will be of benefit to the people of Alaska, the State and the Nation.

If you have questions on the forgoing, I will be pleased to respond. Thank you for all support that you give to U.S. Borzx Quartz Hill Project.

Sincerely,

E. C. H. Beistline
Earl H. Beistline
Dean and Professor of Mining Engineering, Emeritua
University of Alaska-Fairbanks
EHB/jc

cc: Mr. Robert S. Burd, Director
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Colonel Wilbur Gregory, Diatrict Engineer
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, Alaska 99506-0898

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, Alaska 99811

7

JERNBERG BUILDING
111 STEDMAN STREET

SHUHAM & MILNER, P.C.
CERTIFIED PUBLIC ACCOUNTANTS
111 STEDMAN, SUITE 101
KETCHIKAN, ALASKA 99901

907-225-4173

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May 2, 1987

Mr. Win Green
Forest Supervisor
Forest Service, USDA
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

Thia letter is being written to express our wholehearted support for the plan of U. S. Borax to develop the molybdenum find at Quartz Hill located within the Tongass National Forest.

As a small busineasman working in Pelican and Ketchikan, Alaska aince 1947, we have watched with interest the mineral exploration activities in Southeastern Alaska from as far north as Yakobi Island (Dean Goodwin, a bush pilot with a magnetometer strapped to the passenger's seat in a small float plane akimming at tree-top level) to as far south as the lower end of the Panhandle where a Canadian group discovered a large mica deposit on the lower reachea of Portland Canal.

While those early daya may have been filled with more flamboyance, our earlieat recollection of responsible exploration was marked by the mid-1950a arrival of Ted Schaasberger, an engineer with the old Climax Molybdenum Co. (now part of AMAX, Inc.) who came to SE Alaska searching for molybdenum. Mr. Schassberger painstakingly studied every bit of information we could give him in order that he could help his company conform with federal and Alaaka rules respecting payroll and payroll-related taxes and workera' insurance. We understood from others that he was equally conacientioua in his field work and, had his exploration efforts been succesaful, we feel certain that he would have been equally meticulous in helping his company match or exceed the established environmental atandards.

Similarly with the U. S. Borax people who have been coming to Ketchikan for the paat five years, there is nothing of a carpetbagger "get rich and get out" attitude about them. They are low-key, factual and straightforward. When it became apparent to U. S. Borax that it had found a commercially sound body of ore that could call for its long-term presence in Ketchikan, it hired a most respected local resident to head its Ketchikan office on a permanent basis.

We have been following U. S. Borax's Ketchikan activities in the preas and on the radio, have read anti-development publications, have

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Mr. Win Green
May 2, 1987
Page 2

heard a few anti-development comments and have attended U. S. Borax-sponsored public information meetings. We are convinced that this company has exhaustively researched the problems that it faces and that it is sincere in ita statement that it shares all of our concerns for the social and economic well-being of Alaska's future.

We are in favor of giving U. S. Borax what little it is asking for, viz. a fair opportunity to develop a source of molybdenum that can be competitive in a worldwide market. Given a moderate improvement in the presently depressed price of molybdenum, U. S. Borax believea that it can be competitive if allowed to dispose of ita mine tailings in Wilson Arm as is the preferred alternative in the USFS draft Environmental Impact Statement. Based upon its performance to date, U. S. Borax has earned our enthusiastic support.

Very truly yours,

Walter W. Shuham, CPA

cc: Mr. Robert S. Burd
Director, Water Division
Region X, U. S. EPA

Col. Wilbur Gregory
District Engineer
U. S. Army Corps of Engrs.
Anchorage

Mr. Bob Grogan
Director
Office of the Governor
Division of Governmental Coordination
Juneau

8

DRS WILSON AND SALNESS, P C
ARTHUR N WILSON, M.D., 1898-1983
JAMES A. WILSON, M.D., F A C S
ARTHUR N WILSON, JR., M D
TY A SALNESS, M D
P O BOX 8678
KETCHIKAN ALASKA 99901

May 4, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am writing this letter to you to express my support for the U.S. Borax Quartz Hill Molybdenum project.

Having reviewed the recent environmental impact statement, as well as following the testimony of the president of U.S. Borax at his recent Ketchikan visit, I wish to go on record as affirming the benefit to Alaska and to Southeastern particularly if this project is allowed to proceed in a timely and economic fashion.

It seems obvious that in order to produce molybdenum at this site U.S. Borax needs to be competitive. This means that the lower cost tailing disposal in Wilson Arm should be given a high priority rather than the much more expensive proposal for the main arm at Quadra. I believe that because of the shift work proposal at the mine that a fair number of people from Ketchikan as well as the smaller towns in Southeastern Alaska could be expected to be hired to be working at the mine and thus benefiting widely the area. In order to do this and to give Southeastern Alaska a wider, broader economic base, less dependent upon the logging industry and fishing, that reasonable economic control and regulations should be enforced.

I further wish to go on record that I think by now that this project has been studied to death and it is time to, in the vernacular, stop cutting bait and go fishing, and give the project clearance to be built in an effective and economic manner for the good of all of us.

Sincerely yours,

James A. Wilson MD FACS

James A. Wilson, M.D., F.A.C.S.

JAW/mc

cc: Mr. Robert Burd
Col. Wilbur Gregory
Mr. Bob Grogan

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Thorne Bay AK
May 5, 1987

Dear Mr. Green,

I would like to voice our opinion on the Quartz Hill project. I think the benefit to the people of Alaska in terms of economic value far outweighs the problems + dangers to the environment. With reasonable controls, it can really benefit the community of Ketchikan by creating jobs, + also a very useful product.

Thank you
Reuben C. Rose
Joanna R. Rose

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10

Ed Craig, O.D.
Doctor of Optometry
348 Main Street
Ketchikan, Alaska 99901

Telephone (907) 225-3975

Visual Training
Contact Lenses

May 5, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am in favor of U.S. Borax development of Quart Hill in an economical manner.

I would favor disposing the tailings in Wilson Arm and developing wells for water to lower the cost of building a large dam.

Very truly yours,

Ed Craig
Ed Craig, O.D.

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American Optometric Association

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May 5, 1987

Mr. Win Green, Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The social and economic well-being of the State of Alaska is dependent upon the development of its resources. The resource with the most potential is its minerals; much of which is unexplored. Also, mineral development can generate significant revenue with minimum land use impacts.

To be beneficial, such mineral development must be cost competitive. Therefore, I urge all Federal and State agencies to support the permitting of the Quartz Hill project to protect its economic viability as well as the environment.

I believe this can best be accomplished by allowing Wilson Arm for the tailings disposal (a significant cost saving alternative) and by limiting environmental impacts to essentially one drainage basin.

Sincerely,

Eugene D. Smith

Barbara Smith

335 Wonderview Drive
Glendale, CA 91202

cc: Mr. R.S. Burd , EPA, Seattle
Colonel Wilbur Greogry, Corps of Engineers,Anchorage
Mr. Bob Grogan, Office of the Governor, Juneau, AK

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10 Sharman Place,
Fort Madisor, Iowa
52627
May 5, 1987

Mr. Win Green
Forest Supervisor, Forest Service
United States Department of Agriculture
Federal Building,
Ketchikan, AK 99901

Dear Mr. Green:

I support the Quartz Hill project as proposed by U. S. Borax.

I formerly did some consulting for U. S. Borax regarding the milling and plant operations of Quartz Hill material. In my meetings and discussions with U. S. Borax personnel, I was convinced that they were very concerned about sound and secure environmental practices and controls.

The project is vast and long term. I believe Alaska is fortunate to have a company like U. S. Borax to develop this important element.

I encourage all interested parties to allow U. S. Borax to proceed with the Quartz Hill project. It would benefit the State of Alaska, socially and economically, for a long time.

Sincerely,

Harold Koehler

Harold Koehler

HK:mk

cc: Mr. Robert S. Burd
Director, Water Division
Region X,
U.S. Environmental Protection Agency

Colonel Wilbur Gregory
District Engineer
U.S. Army Corps of Engineers

Mr. Bob Grogan
Director
Office of the Governor
Division of Governmental Coordination
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Juneau, AK 99811

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IRELAND TRANSFER & STORAGE CO.

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May 6, 1987

Mr. Win Green, Forest Supervisor
U. S. Forest Service
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I just returned from Juneau where I followed the Borax officials on my way to the "1987 Symposium on the Economic Future of Southeast Alaska".

Where some 200 of us were working together to promote or generate some economic growth and stabilization throughout Southeast Alaska, we heard from the "What-if syndrome" kooks, that the Quartz Hill project will have to go into the Quadra with their tailings no matter what. This coming from the various state and federal offices in Juneau that were present for the Borax presentation. In fact, after the hearing, Eric McDowell of The McDowell Group, indicated in his speech at the symposium, that the Quartz Hill project is from ten to twenty years away.

This area of Alaska needs the year round economic stabilization that the Quartz Hill project would bring. All local businesses suffer from an extreme over-capacity for nine months out of the year to be ready for the summer influx of visitors, the fishing industry operations and the logging. Logging is working on a program to spread its impact over more months of the year, but fishing and the visitors are mostly confined to the summer months.

As I was born and reared in this area, I am familiar with the Quartz Hill properties and am convinced that the environmental values can be maintained right alongwith the social and economic considerations of this project. I urge you to support the Wilson Arm tailings disposal site and to grant the needed project permit. Thank you for your consideration.

13

Sincerely,

Ralph M. Bartholomew
"A 64 year resident"

Copy:
Robert S. Burd, Director
Water Div'n Region X
Evironmental Protection Agency
1200 Sixth Ave.,
Seattle, WA 98101

Colonel Wilbur Gregory, District Engineer
U S Army Corps of Engineers
P O Box 898
Anchorage, AK 99506-0898

Bob Grogan, Director Office of the Governor
Div'n of Governmental Coordination
Pouch AM
Juneau, AK 99811

14

R. W. BECK AND ASSOCIATES, INC
ENGINEERS AND CONSULTANTS

PO BOX 2400
SITKA, ALASKA
99835

FOURTH & BLANCHARD BUILDING
2121 FOURTH AVENUE
SEATTLE, WASHINGTON 98121
206-441-7500

PO BOX 6818
KETCHIKAN, ALASKA
99901

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FILE NO HH-0000-BD-CA
A4-1

May 6, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

Subject: Quartz Hill Project

When Forest Service personnel flip the light switch on in their offices and homes in Sitka and Ketchikan, they are using electricity generated for the most part by hydroelectric facilities at Green Lake and Swan Lake; brought on-line by R. W. Beck and Associates (Beck) from initial site selection studies begun in the mid-1970's. We have performed feasibility studies, rate studies, electrical load forecasts, and environmental studies for the Alaska Power Authority and municipalities from Skagway to Ketchikan. Beck is no newcomer to the environmental, economic and social arena in southeast Alaska.

During almost 20 years of working with these panhandle communities, we have become thoroughly familiar with the hardships wrought by having to depend upon a narrow economic base. We are also well aware of the concern Alaskan's share regarding their environment, its protection and the careful regard the Forest Service has for multiple-use management on the Tongass National Forest.

Our experience in southeast Alaska leads to a concern for the region's social and economic future. We have seen how fluctuations in supplies of fish and markets for timber have led to economic instability in the past. We urge the Forest Service to support development of the Quartz Hill Project as a major measure to curb such economic instability by providing the diversity and certainty needed for a secure future. The Quartz Hill Project can be an important element in that future.

We believe, however, that any development, whether it be hydroelectric power or mining, must balance economic considerations against environmental controls so that the development of one resource is not at the

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expense of another. Where environmental tradeoffs are not markedly different, as in the selection of a marine disposal site for mine tailings we favor the site that gives the Quartz Hill Project the economic edge to compete successfully on the world market. Therefore, we favor the Wilson Arm/Smeaton Bay disposal site.

We hope you will consider and approve the development of the Quartz Hill Project. If we can be of any service in providing information or answering questions regarding our work in southeast Alaska, please call me at (206) 441-7500.

Very truly yours,

R. W. BECK AND ASSOCIATES, INC.

Donald R. Melnick

Donald R. Melnick
Vice President

DRM/rhm (7792X)
cc: Robert S. Burd
Col. Wilbur Gregory
Bob Grogan

15

POOL ENGINEERING, INC.

Engineers & Constructors
PO Box 6000 • Ketchikan, Alaska 99901 • (907) 225-6684
Contractors License No AA 1946

May 8, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: Draft EIS For Quartz Hill Molybdenum Project

Dear Mr. Green:

As a private company involved in the construction and engineering fields in Ketchikan for over 15 years, we are keenly aware of the potential impacts to the community which may result from development of the Quartz Hill project. We are also keenly aware of the extraordinary effort by both private and government concerns to develop a project plan which minimizes the chance for significant negative impact to environmental, social and economic values.

The proposed mine plan appears to strike a good balance between these three interdependent and often contradictory concerns. To attempt optimization of one concern without considering effects on the others is likely to upset the balance irreparably. Specifically, to require disposal of tailings in Boca de Quadra and prohibit use of well fields for water supply, for what has been clearly demonstrated to be negligible difference in environmental impact, will place an unnecessary load on the project to meet economic and social concerns. We therefore strongly support the alternatives of tailings disposal in Wilson Arm/Smeaton Bay and the use of well fields to provide near and long term water to supplement the proposed water supply dam on tunnel creek.

The Ketchikan area will be subject to declining activity in two major sectors of the economy; government, as oil revenues continue to decline and timber, as prime private timber is logged off. A project such as the Quartz Hill Mine is needed to provide social and economic stability

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into the next century. The preferred alternative identified by the U.S. Forest Service for mine development will provide the best chance for the mine to become a reality and provides a more than adequate level of protection for the environment.

Sincerely yours,

POOL ENGINEERING, INC.

Charles Pool

J. Charles Pool
President

CP/adp

cc: Mr. Robert S. Burd
Director, Water Division-Region X
U.S. Environmental Protection Agency

Colonel Wilbur Gregory
District Engineer
U.S. Army, Corps of Engineers

Mr. Bob Grogan
Director
Division of Governmental Coordination

16

THE LANDING
•MOTEL•RESTAURANT•LOUNGE•

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May 2, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Win,

The Quartz Hill project is important to Ketchikan and Alaskas future and it is crucial that they be allowed to be competitive in the market. To do this they must be have tailings disposal in Wilson Arm/Smeaton Bay.

Enviromental controls must be reasonable and be balanced by economic considerations.

I have studied the reports and feel there is not enough differences in the sites to cause what appears will be a hardship to the company going ahead with the project.

I am an avid sportsfisherman and like many concerned with the enviroment and do not feel that the Wilson Arm site will cause any problem.

Sincerely,

Terral F. Wanzer, Owner
THE LANDING

cc Mr. Robert S. Burd, U.S. EPA
Colonel Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Office of Governor, State of Alask
Senator Ted Stevens

3434 Tongass • Ketchikan, Alaska 99901 • 225-5166
Owners Kay Sims and Terry Wanzer

17

THE GILMORE HOTEL
326 Front Street, Ketchikan, Alaska 99901
Owners Kay Sims and Terry Wanzer
(907)225-9423

USDA-FOREST SERVICE
KETCHIKAN AREA
RECEIVED
MAY 11 '87
FOREST SUPERVISORS OFFICE

May 2, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Win,

I would like to go on record as supporting the Quartz Hill Project and urge your offices to allow the tailing disposal in the Wilson Arm/Smeaton Bay site.

Environmental controls are important but should be balanced with social and economic considerations. The future of Ketchikan is clearly at stake.

I grew up and raised my family here in Ketchikan but the present economic picture in the area has forced my grown children to move on to other states. For Ketchikan and Alaska to have a future projects like Quartz Hill must be allowed be competitive and viable.

Please consider the PEOPLE as well as the fish.

Sincerely,

Kay Sims

Kay Sims, Owner
THE GILMORE HOTEL

cc Mr. Robert S. Burd, U.S. EPA
Colonel Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Office of Governor, State of Alask
Senator Ted Stevens

18

THE UNIVERSITY OF BRITISH COLUMBIA
6270 UNIVERSITY BOULEVARD
VANCOUVER, B.C., CANADA
V6T 1W5

DEPARTMENT OF OCEANOGRAPHY

May ~~4, 1987~~

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchican, AK 99901

Dear Mr. Green,

I have been asked to comment on the U.S. Borax proposal to develop the Quartz Hill Project, including the disposal of tailings in Wilson Arm/Smeaton Bay. I participated in evaluating the biology of alternative site proposals and I am currently involved in a similar project regarding the disposal of mine tailings by Utah Mines at Port Hardy, B.C.

Of the many environmental impacts with which I have been associated, the marine disposal of mine tailings, having an almost undetectable lethal toxicity as measured by the LD_{50} response, is one of the most innocuous anthropogenic activities which I have encountered. Essentially the U.S. Borax marine disposal is similar to temporally enhanced glaciation whereby rock is ground into glacial flour to be deposited in the sea. The long term change in the ecology of the inlet is from a deep rocky ecology to a shallow, soft bottom ecology - the latter state being in fact a generally more productive habitat.

I believe that the tailings disposal can go ahead in the Wilson Arm/Smeaton Bay fjord, providing a regular environmental monitoring program similar to that at Utah Mines, is made part

of the operational permit. At Utah Mines, a considerable quantity of data has been accumulated over the years. These data are part of the public record and they have proved very useful in providing a rapid response to any "off the cuff" criticisms while at the same time satisfying the more thorough concerns of our environmental agencies.

Yours sincerely

T.R. Parsons

T.R. Parsons

Professor

TRP/ber

cc Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

19

USDA FOREST SERVICE
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5-8-87

Mr. Win Green
Forest Supervisor USFS
U.S. DEpt. of Agriculture
FEderal Building
Ketchikan, Ak. 99901

RE: U.S. Borax Quartz Hill Project

Dear Mr. Green,

We are totally in support of U.S. Borsx's Quartz Hill project and wish to be listed with the yes votes on tailing deposal in Wilson Arm.

In order for Alaska to survive so that our children and their children can live in this fantsstic state that we have all worked many hard years to develop, we need new varied businesses.

It certainly seems reasonable that one very small corner of our State can be used to it's best economic use and that the environmental controls be reasonable.

Our family roots go bsck to pre-1914 when the Hadley mine was opened and brought our family on the Oaksmith side to Southeastern Alaska. This branch of the family has existed peacefully with the fishing and timbering branches; and we have all been sble to make a living.

Our younger members who are all migrating south need the same opportunity to work in varied fields in their home state. It is hard for us and our parents to lose them due to unemployment and lack of opportunity!

Let's all turn this trend around--all families are feeling it-and get to work together for our common good.

Sincerely,

Stan A. Oaksmith III
Bonnie L. Oaksmith

20

MADISON
LUMBER & HARDWARE, INC.
2557 Tongass Ave
Ketchikan, Alaska 99901
Phone
907 225 9828

May 10,1987

Mr. Win Green, Forest Supervisor
U.S.F.S. Federal Building
Ketchikan, Ak, 99901

Dear Mr. Green.

I would like to reiterate my feelings expressed in my last letter to you regarding the Quartz Hill mine.

I feel very comfortable with the studies done that show no adverse impact from tailings disbursement in Wilson Arm over Boca de Quadra. U.S. Borax has spent more than ample time and money to show these results.

It is now time for economic consideration of the question. It is time for reasonable people to look at both sides of the question with fairness. It can be shown that cost savings using Wilson Arm would make the operation of the mine more stable during price fluctuations as well as contribute to earlier start up.

Ketchikan appears to be reaching the bottom of a disasterous economic swing and it is my sincere desire to see a substantial industry such as U.S. Borax enter our area to keep jobs and incomes on a more stable year round basis.

I strongly urge your consideration for the most economically responsible method of protecting the environment while allowing the industry reasonable up front projections of cost. I feel this can be accomplished by allowing tailings disposal in Wilson Arm.

USDA FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

Sincerely,

Robert Adams, President
Madison Lumber & Hardware Inc.

21

348 Main Street
Ketchikan, Alaska 99901
May 5, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am concerned with the social and economic future of Alaska.

I share the view that the Quartz Hill Project can be an important element in that future.
I believe that environmental controls should be reasonable and that they must be balanced by economic considerations.

Therefore, I am in favor of U.S. Borax development of Quartz Hill in an economic manner and I am in favor of disposing the tailings in Wilson Arm and developing wells for water to lower the cost of building a large dam.

I am a 40 year resident of the State of Alaska.

Very truly yours,

Virginia Craig

Virginia Craig

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May 4, 1987

3300 W. 30th Ave.
Anchorage, Ak. 99517

TO Mr. Win Green, Forest Supervisor
Forest Service, U. S. Dept. of Agriculture
Federal Building
Ketchikan, Ak. 99901

Info Mr. Robert S. Burd, Director
Water Div., RegionX
U. S. Environmental Protection Agency
1200 Sixth Ave
Seattle, Wa. 98101

Info Colonel Wilbur Gregory
District Engineer
US Army, Corps of Engineers
PO Box 898
Anchorage, Ak 99506-0898

Info Mr. Bob Grogan, Director
Office of the Governor
Div. of Governmental Coordination
Pouch AM
Juneau, Ak. 99811

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Gentlemen:

Regarding specific aspects of the Quartz Hill Project--there is an obvious need for tailings disposal in Wilson Arm Smeaton Bay, and to issue a permit for the project so that both the economic competitiveness of the project and the environment receive protection. The reason is clear in that Quartz Hill can benefit the people of Alaska only if it becomes a low cost, competitive source of molybdenum.

Because we are concerned with the social and economic future of Alaska; and because we share the view that the Quartz Hill Project can be an important element in that future; and because we believe that environment controls should be reasonable and balanced by economic considerations for the benefit and welfare of the people of Alaska,

We ask that you please issue a permit consistent with the above considerations, and let U. S. Borax get on with the project in a manner appropriate to the considerations.

Sincerely,

Kenneth B. Gorton Sr.
KENNETH B. GORTON, SR.
Colonel, USAF, Ret.

Margit V. Gorton PhD
MARGIT V. GORTON, PhD

23

New Mexico Tech
Department of Mining Environmental & Geological Engineering
Socorro, NM 87801
(505) 835-5345

May 7, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

By the title of my department you can see that mining-environmental-geological engineering work in close harmony here at New Mexico Tech. We are most familiar with the Quartz Hill Project of U. S. Borax. We have obtained all of the environmental impact reports along with film documentation of the entire project. We utilize thes reports and visual aids extensively in our academic program here because we feel the Quartz Hill Project represents the ideal balance between mineral development and maintenance of the environment in National Forests. If the venture is allowed to proceed the citizens of the Ketchikan, Alaska and the other 49 states will be the benefactors of jobs, taxes paid, and the availability of an internationally needed metal. And, from what I have gleened from the vast volume of reports on the vegetation, wildlife, climatology, fish migration, etc. the scientific community has at its finger tips a treasure chest of new information on the natural environment of southeast Alaska. The prudent person who carefully examines the impact of the mining activities on the ecosystem at Quartz Hill must conclude that the impact is very minimal. Furthermore, the marine disposal of concentrator tailings in Wilson Arm is by far the most sound alternative.

Sincerely,

George B. Griswold
Chairman

GBG:cr

cc: Robert S. Burd
Colonel Wilber Gregory
Bob Grogan

P.S. While I am now a New Mexican, I worked on Dredge No. 6 for Fairbanks Exploration out on Ester Creek in 1947-48 when Alaska was still a Territory. Much later, in the 1970's I managed Getty Oil's mineral exploration in western Canada and Alaska. So I know and love Alaska!

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24

Alaska State Legislature
House of Representatives

6035 TANAINA DRIVE
ANCHORAGE, ALASKA 99502
(907) 243 8110

WHILE IN JUNEAU
POST OFFICE BOX V
JUNEAU, ALASKA 99811
(907) 465 4993

REPRESENTATIVE DRUE PEARCE
DISTRICT 9, SEAT A
MINORITY WHIP

May 10, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a member of the House of Representatives for the State of Alaska, I am very concerned about the social and economic future of our state. I believe that we need to expand our base and move forward with projects that are economically viable and environmentally secure.

Therefore, I am writing to inform you of my support for the Quartz Hill Molybdenum Project in Ketchikan. The jobs and tax revenues acquired by the state as a result of this project are significant especially given lower oil prices and the forecasted decline in North Slope oil production.

I believe in order to ensure steady employment and additional tax revenues to the state, we must balance environmental controls with the technical merits and economic viability of this project. I hope you will give careful consideration to the Wilson Arm/Smeaton Bay tailing disposal site as I view it as an important decision for the future of the project.

The Quartz Hill Project can play an important role in the future of Alaska and especially in the economically depressed area of Ketchikan. I hope that you will see fit to move forward in an expedient manner.

Sincerely,

Drue Pearce

Ms. Drue Pearce
~~Alaska~~ State House

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

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P.O. Box 923
Ward Cove, Alaska 99926

May 12, 1987

Mr. Win Green, Forest Supervisor
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

This letter is written to support the U.S. Borax position concerning outfall location and water supply.

FIRST - A bit of personal information. The undersigned have lived in Ketchikan, Alaska since May 1954. We are ardent outdoors people. We are very familiar with the Misty Fjords area.

ADDITIONAL BACKGROUND - We have followed very closely the exemplary manner in which U.S. Borax has done their research and the conclusion reached. They are also to be commended for their continuing effort to keep the public informed.

OUR POSITION AND WHY - We are convinced the Wilson Arm outfall is the appropriate tailings disposal site. Wilson Arm makes environmental and economic sense. Their water source position also makes sense. Opposition appears to be nothing more than "The Sky Is Falling Down" snydrome. Solid and valid research indicates--NO PROBLEM.

CONCLUSION - The Quartz Hill Project is environmentally sound, the Company is honorable and concerned and our community desperately needs the economic diversification the project would provide.

The Quartz Hill Project should be taken off "hold" and immediately placed on "go" status.

Thank you.

Sincerely,

Pat & Les Hook

Pat & Les Hook

cc Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

26

Coastal Machinery Inc.
P.O. Box 999 • Ward Cove, Alaska 99928 • 907-247-2228
5295 Glacier Highway • Juneau, Alaska 99801 • 907-780-4030

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May 12, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: U.S. Borax Quartz Hill Project

Dear Mr. Green,

We are in full support of the Quartz Hill Project and the selection of the economically favored tailings disposal site of Wilson Arm/Smeaton Bay. We feel confident that U.S. Borax's numerous studies substantiates the choice of that disposal site and shows reasonable, minimal environmental impacts.

The Project would be a definite asset to the depressed economy of the Ketchikan area and the State of Alaska. It would benefit the United States by not having to depend on unstable foreign markets with U.S. Borax being able to supply a low-cost, competitive source of molybdenum.

We ask that you support the Project as submitted. We believe that environmental controls should be reasonable and that they must be balanced by economic considerations. Thank you for your time.

Sincerely,

COASTAL MACHINERY INC.

Robert B. Elliot

Robert B. Elliot
President

RBE:bj

cc: Mr. Robert S. Burd, Director, Water Division U.S.E.P.A.
Colonel Wilbur Gregory, District Engineer, U.S. Army Corps of Engineers
Mr. Bob Grogan, Director, Division of Governmental Coordination
Mr. Don Finney, Ketchikan Manager, Quartz Hill Project, U.S. Borax

CONSTRUCTION AND MINING SUPPLIES SALES • SERVICE • RENTAL

27

Alaska State Legislature

Senator Paul A Fischer
Senate District D
Box 784
Soldotna, Alaska 99669
(907) 262-9420 W
262-9269 H

State Senate

While in Juneau
Pouch V
Juneau, Alaska 99811
(907) 465-3791

May 11, 1987

Win Green, Forest Supervisor
Forest Service, US Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Win:

The Pacific Coast Molybdenum Company's Quartz Hill Project being developed in southeastern Alaska represent the effort of Alaskans to develop the vast mineral wealth found in our natural resources. I would like to add my name to the substantial list of persons supporting the effort.

This Project represents a return to the dynamics of the free enterprise system with its sensitivity to protect both environment and economy.

I hope that I can depend upon your considerable influence to see that this project receives the support necessary to launch it as a viable influence in Alaska's social and economic future.

Cordially,

Paul Fischer

Paul Fischer
Senator

PF:mal
cc: Robert S Burd, US Environmental Protection Agency
Col Wilbur Gregory, US Army, Corps of Engineers
Bob Grogan, Alaska Div of Governmental Coordinati

28

NORMAN A. WILSON
SNOW CONSULTANT SERVICES • P.O. BOX 8010 • TRUCKEE, CA 95737 • (916) 587-1593

AVALANCHE CONTROL
SITE PLANNING
AVALANCHE ZONING
OPERATIONS PLANNING TRAINING
EXPLOSIVES TRAINING
TECHNICAL WITNESS

12 May 1987

Mr Win Green
Forest Supervisor
USDA-Forest Service
Federal Building
Ketchikan AK 99901

Dear Mr Green:

This is written to request your support for the Forest Service Preferred Alternative for tailings disposal at the Quartz Hill Molybdenum Project.

I believe that a viable project at Quartz Hill will provide many and various benefits for the people of Alaska and for the United States.

I further believe that Quartz Hill must be competitive in the world market in order to be a viable project, and that reasonable environmental controls are critical to achievement of a competitive position.

I believe that the environmental effects of the project should be considered in the context of the long term: Surely, some environmental effects must occur in any human undertaking -- be it creation of a farm, a home, a ski area, or a molybdenum mine -- but the projected life of the mine is only fifty-five years; and this is a wink of an eye in geologic time. Thus, the adverse effects that will occur will be, in the context of the long term, very short lived. I suggest, in fact, that one could equate the discerned adverse effects with the effects of one or two of the earth slumps and landslides which seem to be naturally occurring with regularity in the general area of the project.

Some adverse effect on the underwater life will occur during the course of the project; but this will occur in either Boca de Quadra or in Wilson Arm. If there is a potential difference in amount or degree of adverse effects in the two fjörds, I believe the benefits that will accrue to the citizens of Alaska and to the United States from a viable project at Quartz Hill will outweigh that potential difference.

Very truly yours,

N.A. Wilson

Norman A Wilson

cc: Mr Robert S Burd
Colonel Wilbur Gregory
Mr Bob Grogan

29

PORT OF
GRAYS HARBOR

COMMISSION

JOHN H STEVENS • GERALD S TERRELL • J K LEWIS

HENRY E SOIKE, General Manager

May 12, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

We represent a region on the Washington State coastline which will benefit substantially from the Quartz Hill Molybdenum Project. Pacific Coast Molybdenum has identified a site in Hoquiam, Washington, as the location for their refinery. The 130 direct jobs and $50 million capital investment which would result from their decision to construct a refinery would be a godsend to our depressed economy. In addition to the broad socioeconomic benefits which would accrue to our region, there are equal or greater benefits to southeast Alaska.

The key issue at this time appears to be tailings disposal from the mine. We have reviewed the forest service preferred alternative in the revised DEIS, and wish to go on record as strongly supporting this alternative. Not only does it avoid construction of facilities for tailings disposal in a designated wilderness area, it will result in a $59 million up-front cost savings and will eliminate a $1.6 million annual expenditure. Environmental safeguards afforded by disposal in the deeper water of Boca de Quadra are more than offset by the economic advantages of disposal in Wilson Arm/Smeatom Bay.

Given the minor differences in environmental impact between tailing disposal in Wilson Arm/Smeaton Bay vis-a-vis Boca de Quadra, and the very large differences in socioeconomic benefits, we strongly urge you to stay with the marine disposal in Wilson Arm/Smeaton Bay alternative.

Sincerely,

PORT OF GRAYS HARBOR

John Stevens

John Stevens, President
Port of Grays Harbor Commission

cc: Robert S. Burd, EPA
Col. Wilbur Gregory, Corps of Engineer
Bob Grogan, Office of the Governor, Alaska

P O BOX 660 • ABERDEEN WASHINGTON 98520 0141 • (206) 533 9528 • FAX (206) 533 9505 • SCAN 579 9528

30

Alaska State Legislature
Senate Resources Committee

Box V
Juneau, Alaska 99811
(907) 465-4907

May 12, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Green:

I would like to take this opportunity to give my support to the development of the Quartz Hill Project. It is imperitive to the economic future of Alaska that projects like this go forth without excessive environmental roadblocks.

I would also urge you to allow tailings disposal for the project in Wilson Arm/Smeaton Bay.

Reasonable environmental controls are in everyone's best interest, but please make sure that there is a balance so that this important project can go forth.

Please let me know if my office can be of any assistance to you in this project.

Sincerely,

Jack

John B. "Jack" Coghill

JC/ms

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KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

31

506 Jackson Street
Ketchikan, AK 99901
May 13, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Ak 99901

Dear Sir:

The purpose of this letter is to record support for the Quartz Hill Project.

It is also an appeal for some balance in the policies which guide the administration of the Tongass Forest. Excessive environmental regulation has rendered American industry non-competitive in world markets. In Alaska, where climate, topography and logistics make for high cost production, the additional burden of unreasonable regulation can render viable projects uneconomic even under favorable market conditions.

The very considerable expense U. S. Borax has incurred in researching the environmental effects of a mining venture at Quartz Hill surely identifies the company as a good "corporate citizen". From a financial viewpoint, it will require many years of profitable operation to re-coup the 100 million dollars invested to date.

Even an impartial observer can see that opposition to this project comes from parties who are against any development in south-east Alaska. The minor differences of opinion on tailing disposal should not delay this project, but prudent, economic factors should decide the issue.

To conclude, if south-east Alaska is to enjoy a viable economy (i.e. one that provides a livelihood for our children) then this project should receive maximum support from all agencies and individuals.

Yours truly,

A P Ludwick

A. P. Ludwick

cc: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

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SOUTH EAST REGIONAL RESOURCE CENTER
S.E.R.R.C., INC

218 Front Street • Juneau, Alaska 99801
Phone: (907) 586-6806

May 13, 1987

Mr. Win Green
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I would like to voice my personal support for the Quartz Hill project in general and more specifically, to urge the acceptance of tailings disposal in Wilson Arm/Smeaton Bay.

I am convinced after hearing their presentation that Quartz Hill is a key to our economic future and that if necessary, relaxation of environmental controls should occur so that the project can proceed.

Sincerely yours,

Twyla Coughlin

Twyla G. Coughlin, Ed.D.
Associate Director

cc: Robert S. Burd
Wilbur Gregory
Bob Grogan

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Mr Win Green
Forest Supervisor
Forest Service
U.S. Dept of Agriculture
Federal Bldg
Ketchikan, AK 99901

Dear Mr Green:

I am writing to you, to express my feelings regarding the Quartz Hill Project in southeastern Alaska. The potential economic value to the State of Alaska and it's citizen, by bringing this mine on stream to produce Molybdenum, should be strongly supported. I also believe in order to do this, you must consider the overall cost's to produce the product to make it competitive in the market place, keeping in mind the protection of the environment.

P-20

One of the major decesions we support is to allow the disposing of the mine tailings in the Wilson Arm/Smeaton Bay. The future of Molybdenum is very promising and the opportunity for Alaska to participate in this we hope will encourage you to support the project

Sincerely
John Stewart
4411 Charlemont
Woodland Hills Ca 91364

cc. Mr Robert S Burd
Colonel Wilson Gregory
Mr Bob Grogan

34

Miners Advocacy Council

P.O. Box 83909
Fairbanks, Alaska 99708

May 11, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Burd:

The Miners Advocacy Council supports the tailings deposit in Wilson Arm/Smeaton Bay and the need to permit the Quartz Hill project so that both the economic competitiveness of the project and the environment receive equal protection.

We fail to see any reason why the permitting of the Quartz Hill project with tailings deposit in Wilson Arm/Smeaton Bay should not be done.

Sincerely,

Leslie Noyes
Leslie Noyes
Executive Director

cc: Colonel Gregory
Mr. Burd
Mr. Grogan

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35

JACOBS ASSOCIATES

ENGINEERS AND CONSULTANTS
CONSTRUCTION PERFORMANCE SERVICES

500 SANSOME STREET • SAN FRANCISCO CALIFORNIA 94111 • TELEPHONE (415) 434 1822
TELEX 278 484 JASOC UR FAX 415 956 8502

May 12, 1987

Mr. Win Green, Forest Supervisor
Forest Service, U.S.D.A.
Federal Building
Ketchikan, AK 99901

Reference: **U.S. BORAX QUARTZ HILL MOLYBDENUM PROJECT**
REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Green:

This letter is written in support of a decision that will allow the Quartz Hill Molybdenum Project to proceed. It is our understanding that a key factor the Board of Directors of Pacific Coast Molybedenum will consider before making a decision to proceed to make a very large investment, is the economics of tailings disposal. A clear case has been made that tailings disposal in Wilson Arm/Smeaton Bay is very substantially more economical than disposal in Boca de Quadra.

We are pleased with your position on tailings disposal that the preferred alternative is marine disposal in the Wilson Arm, but are very concerned that the Environmental Protection Agency has concluded that the Boca de Quadra is the environmentally preferred location. We think the EPA data in support of this premise is based on assumptions that are too conservative, and in any case, the EPA has considered only the marine environmental values. In our opinion, the EPA has not given sufficient weight to the facts that disposal in Wilson Arm will result in the impact of mine development being confined to a single drainage and it would not be necessary to put tailings disposal facilities in the designated wilderness area as would be required for the Boca de Quadra alternatives.

#1

#2

On this last point, we understand that you are particularly interested in receiving information which would help assess the significance of the visual and aesthetic effects of the tunnel portal on Boca de Quadra's shoreline. I have been involved in the construction of tunnels and other major civil engineering projects for thirty-seven years and have viewed the specific portal site from a helicopter. I can assure you that even the most minimal construction at the proposed portal will result in a significant scar. The proposed Tailings Tunnel for this alternative would be primarily worked from the Tunnel Creek end. However, it still will be necessary (for safety of the underground work force) to have established a safe portal on the Boca de Quadra hillside before the tunnel can be holed. Although

35

#2 cont.

I have not seen the final design of the proposed tailings disposal facilities, it is reasonable to assume that they will require significant clearing, excavation, and concrete construction. Temporary, and perhaps permanent, access to the area will be required. There can be little doubt that visitors to Boca de Quadra will readily see the scars of construction in this area. If you would like to see what some tunnel portals look like while under construction, I can search my files for some old photos. No doubt the Corps of Engineers or your own agency have similar photos. They are not pretty.

In view of the tremendous long-term economic benefits to the State of Alaska if this project proceeds, I urge you to find that the Wilson Arm/Smeaton Bay submarine tailings disposal area is the preferred alternative, without the qualifications placed in the RDEIS by the EPA.

Very truly yours,

JACOBS ASSOCIATES

A M Petrofsky

A. M. Petrofsky
Executive Vice President

AMP:ag

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Colonel Wilbur Gregory
District Engineer
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, AK 99506-0898

Mr. Bob Grogan
Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

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36

KETCHIKAN GATEWAY BOROUGH
344 Front Street
Ketchikan, Alaska 99901
(907) 225-6151

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May 12, 1987

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, Alaska 99811

Dear Mr. Grogan:

As you know, U.S. Borax has asked that those interested in the development of the Quartz Hill Molybdenum Mine make their concerns and/or support known to you. This project has to date been subjected to extensive study. This study has identified two obstacles which all resource development in Alaska must overcome - world competition and industrial instability. It is these two areas that the citizens of Ketchikan have the highest stake.

The community's best interests are served by a mine that operates as continuously as possible. To burden U.S. Borax with unnecessary capital and operational costs is to ensure that they enter the market last and exit first. The frequent or premature closing of the Quartz Hill Mine would have major negative socio-economic impacts on Ketchikan. Quartz Hill should be designed and permitted to be a state of the art mining operation with the resultant strategic advantages in current and projected worldwide markets.

In closing, it is hoped that the analysis and upfront recognition of reasonable safeguards will persuade the agencies to permit the mine in such a manner to maximize its economic stability and, thereby, the economic stability of the Ketchikan community.

Respectfully,

Ralph C. Gregory
Mayor

Q-22

37

Representative Dick Shultz
Alaska State House of Representatives
P.O. Box V • Juneau, Alaska 99811 • (907) 465-4940
Home: P.O. Box 487 • Tok, Alaska 99780

Member
House Resources Committee

May 13, 1987

Mr. Bob Grogan
Office of Governor
Pouch AM
Juneau, Alaska 99811

Dear Mr. Grogan:

As the economy of Alaska continues to flounder it is essential that projects such as Quartz hill get off the drawing board and into reality.

One aspect crucial to the economic feasibility and health of this project is the disposal site for the mine tailings.

Along those lines I wish to go in record as fully supporting the Wilson Arm / Smeaton Bay option as one that, based on all information I have reviewed, is environmentally acceptable.

If I can be of additional assistance in any way on this project please contact me at once.

Most Sincerely,

Dick

Representative Dick Shultz

cc. Corps of Engineers
EPA
USDA ✓

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38

Ray J. Coleman
1629 La Verde Dr.
Lake San Marcos, Cal. 92069

May 13, 1987

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FOREST SUPERVISORS OFFICE

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Bldg.
Ketchikan, AK 99901

Dear Sir,

Reference is made to the RDEIS for the Quartz Hill Molybdenum Project.

I should first like to express my support for the Project itself and in particular to express my preference and support for the Forest Service's preferred alternative for the marine disposal of tailings in the Wilson Arm/Smeaton Bay. I concur in all of the reasons mentioned for this selection by the Forest Service in the Summary RDEIS including specifically the point that the reduced operating and development costs of disposal in the Wilson Arm means greater community stability for Ketchikan and Southeast Alaska. The Quartz Hill Project can become a reality with consequential benefit to the social and economic future of Alaska only if it becomes a low-cost competitive source of molybdenum, and the lower operating and development costs associated with the disposal of the tailings in the Wilson Arm make the selection of this alternative imperative. All reasonable environmental considerations will continue to be served.

Sincerely yours,
Ray J Coleman

cc: Robert S. Burd
Colonel Wilbur Gregory
Bob Grogan
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ENSERCH
Alaska Services, Inc.

May 14, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

Re: U.S. Borax
Quartz Hill Molybdenum Project

It was in February, 1981 when I was President-elect of the Anchorage Chamber of Commerce that I headed a local study group to examine the U.S. Borax Quartz Hill Project. Subsequently, the Anchorage Chamber of Commerce soundly endorsed the project and have actively supported the approval of its permit.

It is unconscionable to realize that here it is, millions of dollars and over 6 years later and the permit still hasn't been issued. With all of the roadblocks thrown against developmental projects by the Federal (and sometimes state) government, no wonder United States products cannot compete in world markets.

#1 Over these years this project has been so thoroughly seived environmentally, why can't the Environmental Protection Agency accept the preferred Wilson Arm tailings disposal site over the Boca de Quadra site? They then would honorably discharge their economic responsibilities together with their environmental responsibilities.

When can we develop confidence in our governmental agencies that indeed they are working in our best interests?

Don't you believe the decision time is here? Certainly U.S. Borax has sustained its responsible reputation. Forget about the economic factors, the Quartz Hill Project merits permitting.

Sincerely,

Alvin H. Fleetwood
Alvin H. Fleetwood
Vice President

ENSERCH Center, 550 West Seventh Avenue Anchorage Alaska
P O Box 7040, Anchorage Alaska 99510-7040 (907) 276-5070

A Subsidiary of ENSERCH Corporation

40

39

TRYCK NYMAN & HAYES

ENGINEERS/SURVEYORS/LANDSCAPE ARCHITECTS
TRANSPORTATION and COMMUNITY PLANNING

PARTNERS
FRANK E. NYMAN
JOHN F. CHAPMAN
LES BRATTAIN
G. CRAIG FREAS
ASSOCIATE
JAMES E. LAKE

0000.0

May 14, 1987

Mr. Win Green, Forest Supervisor
U.S. Department of Agriculture
Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

This is to express my support for approval of the Environmental Impact Statement and issuance of a permit to U.S. Borox for the Quartz Hill Molybdenum Project. After twelve years and a $100 million expenditure, this project has been studied enough. Quartz Hill is a viable economic project which needs to be constructed now in order to infuse money into our depressed economy.

I would also like to state my support for utilization of the Wilson Arm for tailings disposal and the Blossom River well field as the supplementary source of water. Those decisions will provide an environmentally sound project site without placing undue economic burden for marginal, if any, environmental improvement.

Thank you for the opportunity to express my opinion.

Sincerely,

TRYCK, NYMAN & HAYES

Ross B. Dunfee

Ross B. Dunfee, P.E.
Project Engineer

RBD*alv

USDA FOREST SERVICE
KETCHIKAN AREA
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cc: D. L. Finney, Ketchikan Manager
Quartz Hill Project

Mr. Robert S. Burd, Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, Washington 98101

Colonel Wilbur Gregory, District Engineer
U.S. Army, Corps of Engineers
P.O. Box 898
Anchorage, Alaska 99506-0898

Mr. Bob Grogan, Director
Office of the Governor, Division of Governmental Coordination
Pouch AM
Juneau, Alaska 99811

911 West Eighth Avenue • Anchorage, Alaska 99501-3497

41

T.L. CAPION
961 GARDEN
ANAHEIM CA 92801

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May 14, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

In response to your request for comments on the Revised Draft EIS "Quartz Hill Molybdenum Project Mine Development", I offer the following remarks.

In my opinion, U.S. Borax has diligently shown proper environmental concern and exhibited good business practice in the predevelopment phase of the Quartz Hill mine in Alaska. A great deal of money, time and effort has gone into this project to assure the public that Quartz Hill will be a first-class operation and a sound investment in the future of Alaska; that the environment will be well protected.

To help U.S. Borax become a low-cost producer of molybenum and competitive in world markets, it is imperitive that plant tailings be disposed of in the Wilson Arm fjord. Otherwise, the additional capital costs and operating costs to dispose in Boca de Quadra would be required to develop the project. Extensive environmental studies of Boca de Quadra and Wilson Arm fjords have shown that there is very little risk to fisheries from toxic metals in either fjord. U.S. Borax has demonstrated their willingness to protect the Alaskan environment and are mandated to do

#1 so. In their preferred alternative for Boca de Quadra tailing disposal, EPA considered only marine environmental values. I strongly believe that environmental controls should be reasonable and balanced between environmental, economic, social and wilderness values.

Economically, the Quartz Hill project will provide over 1000 permanent jobs and contribute significantly to the Alaskan economy.

41

Mr. Win Green
May 14, 1987
Page Two

The development of the Quartz Hill project is good for Alaska and good for America. During these times when American industry is taking a beating from foreign competition, Quartz Hill looms as one of the bright spots on the horizon. Therefore, I strongly support the Forest Service preferred alternative for tailings disposal in Wilson Arm fjord. In my judgement, the needs of the many outweigh the needs of the few.

Sincerely,

Tom Capion

42

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May 14, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Re: **QUARTZ HILL PROJECT - REVISED DRAFT EIS**

Dear Mr. Green:

If Borax is willing to invest $800 million to $1 billion in the project and, if all of the information that has been gathered to date indicates the project can proceed in a reasonable manner if tailings are disposed in the Wilson Arm, I hope this preferred alternative is accepted and affirmed in the final EIS report.

If "worst case" assumptions are accepted, no project will ever be approved.

Very truly yours,

J.H. Hallahan
22411 Burbank
Woodland Hills, CA 91367

JHH:ob

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Colonel Wilbur Gregory
District Engineer
U.S. Army, Corps of Engineers
P. O. Box 898
Anchorage, AK 99506-0898

43

May 14, 1987

Mr. Win Green
Forest Supervisor
U.S. Forest Service
U.S. Department of Agriculture
Ketchikan, AK 99901

RE: U.S. Borax - Quartz Hill Project

Dear Mr. Green:

I am in total support of tailing disposal in the Wilson Arm - Smeaton Bay area.

As a former long-time Mayor of Ketchikan Gateway Borough, I am satisfied that U.S. Borax has gone the extra mile to find the best solutions to the many questions brought forward over concern for the environment. It is now time to grant U.S. Borax the permit to proceed.

People are a higher form of life in the over all eco system. We too have every right to survive. History has shown we must work to survive. U.S. Borax, at the Quartz Hill mine development will provide a many generation place to be gainfully employed.

Sincerely,

C. G. Fader
Former Mayor
Ketchikan Gateway Borough
1975-1984
P.O. Box 5794
Ketchikan, AK 99901

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44

USIBELLI COAL MINE, INC.
MARKETING
2173 University Avenue So.
Suite 101
Fairbanks, Alaska 99709
(907) 479-2630
FAX 479-2793

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May 14, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska, 99901

Dear Mr. Green:

The preferred alternative identified by the Forest Service for tailings disposals from the proposed Quartz Hill Mine into Wilson Arm is logical and correct. The immense effort attested by the quantity and quality of scientific data generated by a team of top scientists and their subsequent analysis and synthesis is assurance enough that the decision is correct. Emotional issues can be put aside since the evidence is overwhelming that Wilson Arm can receive the tailings with minimum risk of serious adverse environmental consequences.

The approval of the Wilson Arm tailings disposal option does two things:

1) It ensures to the maximum extent that surface disturbances will be confined to one drainage (this is a stated concern of U.S. Congress). To select Boca de Quadra would result in fairly significant disturbance to a fiord which otherwise can be maintained in a pristine condition.

2) It reduces the overall cost of the project while ensuring environmental safeguards which are strict and appropriate.

Since no significant environmental benefits (quite the opposite in my view) accrue to the Boca de Quadra option it is my opinion that supporters of this option are more interested in delaying or killing a project with unwarranted cost burdens. This project is expected to bring significant economic benefit to Southeast Alaska and indeed the entire state once the mine is in production. Economic costs and benefits are therefore important and I would urge that scientific rather than emotional criteria are used to evaluate other unresolved issues such as water supply.

Several years and four environmental impact statements later, it is my earnest hope that Quartz Hill Mine can be permitted in a manner which makes economic as well as enviornmental good sense.

44

Mr. Win Green
May 14, 1987
Page Two

I support the preferred alternative and urge acceptance of this finding.

Sincerely,

John Sims
VICE-PRESIDENT MARKETING

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan
Mr. Don Finney

45

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May 14, 1987
Ketchikan, Alaska

Mr. Win Green
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am a thirty year Ketchikan resident and commercial fisherman, and wish to express my adamant opposition to U.S. Borax's intent to dump their tailings into Wilson Arm and use the water of the Blossom River for their operations.

U.S. Borax is a wholly owned foreign company whose only vested interest is in making a profit for its stockholders. I believe that our government agencies must protect our citizens from the excessive irreversible ecological destruction proposed by U.S. Borax.

Wilson Arm is rich in crab, shrimp, seals and salmon. It is aesthetically beautiful and ecologically pristine. Approximately one million salmon of several different species spawn in the Wilson and Blossom Rivers annually. These salmon represent an extensive, positive economic impact on the people of the United States, Alaska and Canada. The protection of these renewable natural resources must take high precedence in any decision made concerning the mining operations at Quartz Hill.

Dryland storage of tailings and taking water from a non-salmon spawning stream would greatly reduce the environmental impact by allowing better control of the dumping of heavy metals and chemicals into our food chain and protecting the marine habitat.

Sincerely,

Fred Athorp
No.10 Creek Street
Ketchikan, Alaska
99901
(907) 225-3452

CC: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

46

May 15, 1987

Mr. Win Green
Forest Supervisor, Forest Service
U. S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Sir:

It is my unreserved opinion that the disposal of the tailings from the Quartz Hill Molybdenum Mine into the Wilson Arm/Smeaton Bay area will reduce the cost of the U. S. Borax Installation by $59 million Capital Cost and an annual operating cost of $1.6 million with an equivalent savings rate of 55¢ per pound of molybdenum produced. This approach would only increase the worst case fishing cost at Wilson Arm by $5530/year over the Boca de Quadra cost. In addition U. S. Borax is prepared to do whatever is reasonably necessary to assure both the water quality and the fisheries.

With these savings the molybdenum production is insured to be competitive in the world market and assure the monetary stability of Alaska.

These proposals would confine the mine development to a single drainage. The impact on the wilderness area values are thus minimized by decreasing the construction necessary for the tailings disposal at Boca de Quadra Fjord.

My opinion is guaranteed under my Professional Engineers License (Chemical Engineer #CH 002970) in the State of California.

Sincerely,

Francis M. Delach
Francis M. Delach

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FOSSE Mechanical, Inc.

301 BAWDEN STREET
KETCHIKAN, ALASKA 99901
(907) 225-4480

LICENSED SURVEYOR
ENGINEER

May 15, 1987

Mr Win Green, Forest Supervisor
Forest Service, Dept of Agriculture
Federal Building
Ketchikan

Dear Mr Green:

I have attended meetings and read articles pertinent to attached USBorax 'plea' - and am convinced that the company can and will proceed operation in a manner that is not det rimental to the environment. I share with them the opinion that the Wilson Arm disposal is the better tailing doposit area.

Courteously,

Earl L Fosse

Earl L Fosse
Professional Engineer

cc: Mr Robert S Burd
Col Wilbur Gregory
Mr Bob Grogan

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June 15 is the deadline!

U.S. Borax is asking for help on specific aspects of the Quartz Hill Molybdenum project: the need for tailings disposal in Wilson Arm/Smeaton Bay and the need to permit the Quartz Hill project so that both the economic competitiveness of the project and the environment receive equal protection.

The reason is clear: Quartz Hill can benefit the people of Alaska only if it becomes a low-cost, competitive source of molybdenum.

Therefore, if you:

—Are concerned with the social and economic future of Alaska,

—Share the view that the Quartz Hill Project can be an important element in the future,

—Believe that environmental controls should be reasonable and that they must be balanced by economic considerations,

then please inform the Federal and State agencies listed below of your support for the Quartz Hill Project and your position on these issues—

By writing to:

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Send copies of your letter to:

Mr. Robert S. Burd Director, Water Division Region X U.S. Environmental Protection Agency 1200 Sixth Ave. Seattle, WA 98101.	Col. Wilbur Gregory District Engineer U.S. Army Corps of Engineers P.O. Box 898 Anchorage, AK 99506-0898	Mr. Bob Grogan Director Division of Governmental Coordination Pouch AM Juneau, Alaska 99811

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Douglas J. Thompson
Box 6396
Ketchikan, Alaska 99901
May18.1987

Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Mr. Green:

I am writing you concerning the granting of permits allowing U.S. Borax to open pit mine the Quartz Hill site.

I believe that the best multiple use of the Smeaton Bay and Boca DeQuadra area is for recreation and for protection of its valuable salmon spawning grounds. The Forest Service is charged with the oversight of our natural resources to the best advantage of the most people i.e., the concept of multiple use. I believe the future of this region is tied to its only viable growth industry, tourism and its only stable industry, fishing (both commercial and sport charter as well as private use).

I see no binding assurances that that use will not be detrimentally impacted by the U.S.Borax (a misnomer as U.S. Borax is a multinational with headquarters in England and not the least interested in our "national security") project. Indeed most of the work I have seen is the company's own, which is hardly unbiased. In light of the plentiful existing deposits of moly in the lower continental areas and in B.C. Canada, all of which are closer to transportation and market and therefore more efficient to mine, and which more than supply current demand, I find that the advantages of ruining the Quartz Hill area (two watersheds) are far outwieghed by the potential nondepletionary uses.

Therefore in conclusion I ask that the Borax find not be allowed to be mined in the present and forseeable future.

Sincerely,

Douglas J. Thompson

Douglas J. Thompson

cc: Mr. Robert S. Burd, EPA
Col. Gregory, Corp Of Eng
Mr. Grogan, Director Division of Gov. Coordination

49

Hrg
HAWLEY
RESOURCE
GROUP, INC

May 14, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The Quartz Hill Project can be one of the most exciting and valuable projects to get under way in Alaska for a number of years. The U.S. Forest Service personnel in the state cannot afford to do other than give its strongest support in assisting to make positive decisions that allow the project to remain competitive. Delays and excessive environmental controls are the areas in which competitive development could be killed.

U.S. Borax has provided more environmental studies than probably any other project in the world. The Wilson Arm/Smeaton Bay tailings site should be approved. I urge you to help expedite approval so the project can proceed.

Sincerely,

Jenny Hawley

cc: Mr. Robert S. Burd, U.S. E.P.A
Colonel Wilbur Gregory, U.S. Corps of Engineers
Mr. Bob Grogan, State of Alaska

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Port West Inc.

May 14, 1987

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FOREST SUPERVISOR'S OFFICE

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: U.S. Borax Quartz Hill

Dear Mr. Green:

I came to Alaska a few days short of thirty eight (38) years ago. Over this span of years, I have seen many changes in the way the state was, and is being developing. I acknowledge and appreciate the safeguards on input, that industry provides for the licensing agencies, so they may make sound decisions in protecting the many facits of our living world. Public hearings have also assisted the populous to understand the projects in allowing them to have imput before State and Federal Agencies, that issue the required permits. U.S. Borax is such a project in its efforts to develop Quartz Hill.

I have been impressed, from day one, of U.S. Borax dedication to the protection of the environment with great emphasis on air quality, water and the fisheries.

This project will be a great influence in stabalizing the economy of the Ketchikan area. The jobs and other economic benefits will enrich all of Alaska.

The United States needs to become self sufficient in its many requirements in strategic metals, Quartz Hill contains one of these metals.

I can not stand idlely by and see the United States become more dependent on foreign minerals, when Alaska has such an abundant variety and quantity. With todays technology, I am convinced that we can protect the environment with the regulations that are required of the developer.

• PLAZA PORT WEST ■ BOX 5377 ■ KETCHIKAN, ALASKA ■ 99901 ■

50

I support the Quartz Hill project, and for the selection of the economical favored disposal site, namely Wilson Arm/ Smeaton Bay.

Sincerely,

Lloyd F. Hames

Port West, Inc.
Lloyd F. Hames
Chairman of the Board

LFH/bc

cc: Robert S. Burd
Colonel Wilbur Gregory
Bob Grogan

51

ALASKA MINERS ASSOCIATION, INC.

501 W. Northern Lights Blv'd, Suite 203
Anchorage, Alaska 99503
(907)276-0347

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May 17, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U. S. Dept of Agriculture
Federal Building
Ketchikan, Ak 99901

Dear Mr. Green:

This is to advise that the Alaska Miners Association strongly supports the development and mining of the Quartz Hill molybdenum deposit as proposed in the Revised Draft EIS (RDEIS). The proposal calls for a Tunnel Creek mill site, marine tailings disposal in Wilson Arm/Smeaton Bay, and workers living at single status housing at the project site and commuting during days off to Ketchikan. This project will contribute substantially to the now poor economy of the state. It will provide substantial employment and an improved tax base for the state. A decision to move this project along in a timely and responsible manner is needed now.

The most contentious issue is the tailings disposal site, Boca de Quadra vs Wilson Arm/Smeaton Bay. The USFS favors Wilson Arm/Smeaton Bay whereas the USEPA favors the middle basin of Boca de Quadra. We strongly support the Wilson Arm/Smeaton Bay disposal site for the following reasons:

- o the detailed studies that provided input to the RDEIS indicate that there is little risk to the fisheries from toxic metals concentrations in either fjord;
- o responsible development and corrective action by US Borax as required by permit requirements will assure protection of water quality and fisheries — ANILCA mandates that operations be suspended if there is a threat of irreparable harm to the fisheries; EPA has the opportunity of insisting on appropriate monitoring programs to assure that no damage is being done; there is no evidence to support the supposition that this site may cause irreparable damage;
- o the impacts of the mine development will be confined to a single drainage;
- o the impacts on wilderness values will be minimized since it would not be necessary to construct facilities for tailings disposal in the designated Wilderness area as would be required if disposal were in the Boca de Quadra fjord,
- o this site will provide lower capital ($59 million) and operating costs ($1.6 million per annum) for the project development thereby providing for a better chance of project approval by U. S. Borax and for a increased cash flow to the economy;
- o worst case loss estimates to the fisheries in both fjords are infinitesimal compared to the capital and operating cost losses if Boca de Quadra (BdQ) is the mandated site,

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therefore, BdQ should not be considered;

- o the 777 million cubic meters of volume below sill in the Wilson Arm/Smeaton Bay site should easily accomodate the total 55 years of tailings disposal according to the RDEIS and our independent calculations; however, appropriate monitoring will assure that this is this the case.

We appreciate the opportunity of providing our comments and look forward to a timely approval of all permits that, in turn, will provide the Board of Directors of U. S. Borax with the assurance of governmental support. This then will move the project along in a timely and responsible manner. We look forward to a new major mining project in Alaska.

Yours very truly,

Curtis V. McVee

Curtis V. McVee
Executive Director

cc: R. Burd, USEPA
W. Gregory, USC of E
R. Grogan, Office of Governor

52

Alaska Timber Insurance Exchange

111 Stadman St., Suite 201
Ketchikan, Alaska 99901
(907) 225-9451

May 19, 1987

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Mr. Win Green, Forest Supervisor
Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a resident of Ketchikan for more then thirty years I am concerned about the future of the community. The development of the Quartz Hill Project will be an important element of that future.

When Ketchikan Pulp Company was planned and during its construction in 1953-54 there were concerns about its effect on the community and the environment. Following the construction of the mill the citizens of Ketchikan have enjoyed improved roads, schools, communication and transportation with little or no environmental effect on the Ward Cove area. The salmon still find their way to Ward Lake to spawn and the steelhead fishing in Ward Creek continues to improve.

The start up of Ketchikan Pulp Company brought diversification of employment to the area. Prior to 1954 Ketchikan was a one industry, fishing, community and the employment was seasonal. The mill brought a stabilized employment factor to the area.

In my opinion the Quartz Hill Project will bring increased benefits to the Ketchikan area, as did the pulp mill in the early fifties.

I support the disposal of tailings into Wilson Arm/Smeaton Bay - a low cost source of water - and a low cost source of electric power. I also hope the cost for molybdenum ore increases in the near future to permit U. S. Borax to get on with the development of Quartz Hill.

Sincerely,

Donald A. Bell
DONALD A. BELL
President

DAB:cb
cc: Robert S. Burd
Col Wilbur Gregory
Bob Grogan

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Route 2, Box 318
Ketchikan, AK 99901
May 20, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I support U.S. Borax and its Quartz Hill Molybdenum Project; and I believe that the economic stability of Ketchikan depends heavily on this project.

Therefore, in my opinion, it is important that U.S. Borax be allowed to go forward and establish a low-cost, competitive source of molybdenum. More specifically, it is important that the economic viability of the molybdenum project be given at least as much consideration as the environmental concerns.

I realize that it is important to protect our environment. However, certainly there is some common ground on which the Quartz Hill operation can go ahead, while protecting the environment at the same time.

Thank you.

Sincerely,

Louise Brinck Harrington
Louise Brinck Harrington

cc Mr. Robert S. Burd, Director, Water Division Region X, Environmental Protection Agency; Col. Wilbur Gregory, District Engineer, U.S. Army Corps. of Engineers; Mr. Bob Grogan, Director, Division of Governmental Coordination

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FOREST SUPERVISORS OFFICE

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May 18, 1987

Mr. James R. Turner
1621 Old Oak Lane
Arcadia, CA 91006

Mr. W.N. Green
Forest Supervisor
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I have followed the U.S. Borax attempt to develop the Quartz Hill Molybdenum Project in Alaska since its inception. In today's business world, it appears that Quartz Hill can benefit the people of Alaska only if it becomes a low-cost competitive source of Molybdenum. In order for this to happen there is a definite need for tailings disposal in Wilson Arm/Smeaton Bay and the need to permit the Quartz Hill Project so that both the economic competitiveness of the project and environment receive equal protection.

I am sincere in giving my support for the Quartz Hill project and my feelings on the above issues.

With best regards,

J.R. Turner

JRT/ssc

cc. Mr. Robert S. Burd
Director, Water Division
Region X

Colonel Wilbur Gregory
District Engineer
U.S. Army, Corps of Engineers

Mr. Bob Grogan
Director
Office of the Governor
Alaska

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2353 Eastgate Place
Glendale, California 91208
May 18, 1987

Mr. Win Green
Forest Supervisor Forest Service
Federal Building
Letcjolam. Ak. 99901

Re: U. S. Borax Quartz Hill
Molybdenum project.

Dear Sir:

The United States has made serious efforts to maintain an adequate reserve of strategic metals and other essential supplies. Molybdenum is a key metal in the production of many alloys, and we need a dependable, domestic source of supply of this essential metal.

In the development of this supply we must consider a mining and processing operation that will be cost competive during the price cycles that are characteristic of commodity markets.

The studies developed by U. S. Borax over the past 12 years indicate that the economic goals can be reached if the alternate disposal of tailings into the Wilson Arm/ Smeaton Bay is approved.

During the twelve years study, environmental considerations have been studied and are an importent part of the U. S. Borax project.

As a retired chemical engineer I am familiar with the evaluation of handling tailings and process effluents to minimize environmental impacts. The data I have read indicates that the tailings disposal in the Wilson Arm/ Smeaton Bay would meet the environmental requirements over the life of the mine with a conservative safety factor.

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- 2 -

If the U. S. Borax Quartz Hill molybdenum project is approved the United States will have a dependable reserve of a key metal. The state of Alaska will have a new major employer providing jobs for thousands of employees and also provide substantial tax revenue to both Ketchekan and the State.

I respectfully request your support of the U. S. Borax Quartz Hill molybdenum project and the alternative tailings disposal in the Wilson Arm/Smeaton Bay.

Thank you.

Sincerely,

W. J. Diffley

Walter J. Diffley

Copies to:

Mr. Robert S. Burd
Director, Water Division
Region X

Colonel Wilbur Gregory
District Engineer
U. S. Army Corp of Engineers

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination

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UNIVERSITY OF VICTORIA
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DEPARTMENT OF BIOLOGY
TELEPHONE (604) 721 7095
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F&W				
M&WS				
R&L				

May 13, 1987

Edward R. Johnson
Interdisciplinary Team Leader
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901
U.S.A.

Dear Mr. Johnson:

Re: Quartz Hill Molybdenum Project

Your letter distributing the ~~Final~~ Revised DEIS requests comments by June 15.

I have had some previous input, and simply want to add that in the past year I have updated my previous published reviews of the 40+ mines that discharge their tailings to the sea round the world. The attached document was the previous latest.

#1

The new data confirms my previous opinion that tailings from Quartz Hill can be discharged at depth to the sea within the terms of pollution control legislation and regulations such as that in the USA, and thereby have minimal environmental impact which is socially acceptable. I can see no reason why Boca de Quadra should be a preferred alternative over Wilson Arm/Smeaton Bay, and there are environmental reasons for the latter being preferred (see below).

My new reviews are being published this year as follows:

Ellis, D.V. In Press. A Decade of Environmental Impact Assessment at Marine and Coastal Mines. Marine Mining.

Ellis, D.V. In Press. Case Histories of Coastal and Marine Mines. Chapter in Salomons, W. and U. Foerstner (Eds) Management of Mine Tailings and Dredged Material. Springer, Berlin.

Ellis, D.V. and L.A. Taylor. In Press. Biological engineering of Marine Tailings Beds. Chapter in Salomons, W. and U. Foerstner (Eds) Management of Mine Tailings and Dredged Material. Springer, Berlin.

continued on p. 2/...

Mr. E.R. Johnson
May 13, 1987
Page Two

The artifical reef and underwater engineering data, that I reviewed for article No. 3 lead me to the conclusion that Wilson Arm/Smeaton Bay is the environmentally preferable discharge area for Quartz Hill. The reason is that the time is now appropriate for a major project to reduce fiord depth in an attempt to enhance fiord productivity. The combination of Wilson Arm/Smeaton Bay and Quartz Hill tailing provides just such an opportunity with minimal adverse side effects. Boca de Quadra is not so suitable in view of the lesser depth reduction effect possible there.

Yours sincerely,

Derek Ellis

Derek Ellis,
Professor

DE:kr

PROBLEMS OF METAL BIOACCUMULATION ARISING FROM MINING INDUSTRY DISPOSAL OF TAILING TO THE SEA

Ellis, Derek V. Biology Department, University of Victoria, Victoria, B.C., V8W 2Y2

After more than a decade of field investigations, there is no evidence from trace metals monitoring at the many marine discharging mine sites that bioaccumulation can and does spill over into trophic level biomagnification, and thereby put biological resources and human health at risk. Only a few mine sites have such high bioaccumulation levels that they provide adequate field sites for testing the resource significance of laboratory based toxicology research. The case history results demonstrate a need for site-specific interdisciplinary studies of trace metal bioavailabilty, biolocation at inter- and intracellular levels, correlated pathologies and resource impact.

PROBLÈMES DE BIOACCUMULATION DE MÉTAUX PROVENANT DE DÉCHÊTS D'INDUSTRIES MINIÈRES JETÉS À LA MER

Ellis, Derek V. Biology Department, University of Victoria, Victoria, B.C., V8W 2Y2

Après plus d'une décennie d'études sur le terrain, la surveillance des métaux à l'état de traces à plusieurs sites marins de décharges minières n'a encore fourni aucune évidence que l'accumulation dans les tissus vivants se répande et s'amplifie dans les niveaux trophiques et de par ce fait présente un risque pour les ressources biologiques et pour la santé humaine. Seulement quelques sites miniers ont un haut niveau de bioaccumulation tel à pouvoir servir de site de terrain adéquat pour tester la portée de résultats toxicologiques de laboratoire sur des ressources naturelles. Les résultats d'histoire des cas ont démontré un besoin pour des études interdisciplinaires à des sites spécifiques sur la biodisponibilité de métaux à l'état de traces, sur la biolocation à des niveaux inter- et intracellulaires, sur des corrélations de pathologies, et sur l'impact sur les ressources.

Reprinted from: Green, G.H. and K.L. Woodward 1986
Proc. 11th Ann. Aq. Toxicity Workshp. Can. Tech. Repr. Fish. Aq. Sci. #1480

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INTRODUCTION

Coastal mines which discharge their mill tailings to the sea, or to landforms from which metal-loaded streams discharge to the sea, are commonly believed to be the source of toxicological damage to marine resources and even public health. There is now a substantial set of relevant monitoring case histories which allow reviews to determine the following:

[1] Is the social concern justified, and have cases of toxicological damage to resources and public health resulted?

[2] Do the sites provide field testing areas to show whether laboratory based toxicological results are relevant to real ecosystem situations, hence to social needs?

[3] Do the sites provide opportunities for novel toxicological research?

MATERIALS AND METHODS

Thirty-two coastal mines, mining areas or smelters are listed in Table 1. Environmental information is available from at least twenty-four of these. Fifteen of the sites have metal loadings data banks from one or more of the receiving ecosystem compartments, i.e. from the discharged effluent, the water column, sediment particulates, sediment interstitial water, plants, herbivores, particulate feeders and carnivores. Of these sites, five provide extensive data banks more or less systematically covering a broad spatial area encompassing reference stations, and over periods of time ranging up to fourteen years. Undoubtedly there are mines with relevant data other than those listed in Table 1, but it is difficult to obtain information about them for various reasons.

The mine sites with the most extensive metal-related data banks are Island Copper Mine on Vancouver Island, and the Kitsault molybdenum mine in northern B.C. Other west coast Canadian mines provide some information, the combined data bank reflects the traditional practice of discharge to the nearby sea in B.C. and, regulatory agency policy since 1970 has been to permit and monitor this traditional practice to determine impact consequences.

Other areas have undergone intensive investigations of particular metal-related ecosystem compartments. They are the Nanisivik Pb-Zn mine on northern Baffin Island, the Black Angel Pb-Zn mine in Greenland, and the Bougainville Copper mine in Papua New Guinea. In each case there has been a need to ensure protection of subsistence resources for native peoples. Also, oyster stocks near abandoned gold mine estuarine waste dumps in Tasmania have been subjected to intensive investigations of metal uptake.

Table 2 provides lists of species which have been subjected to tissue analyses at the intensively investigated mine sites, and shows the elements for which analyses were undertaken, and the years of sampling. Substantial numbers of species have been tested at some sites, notably Island Copper, Kitsault and Nanisivik. At others there has been a concentration of particular species and elements, e.g. Black Angel (mussels and wolf-fish), Jordan River (littleneck clams), Bougainville (fish) and Tasmania (oysters). At Island Copper a wide range of species adopted for tissue monitoring in 1971 has been modified over

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Table 1. Marine discharging mines and mining areas.

Mine	Main Product	Environmental Impact Assessment	Introductory References
CANADA			
1) Island Copper	Cu/Mo	Extensive*	Pelletier, 1982 Island Copper, 1984 Waldichuk and Buchanan, 1980
2) Kitsault (closed)	Mo	Extensive*	Burling et al., 1981, 1983 Goyette and Christie, 1983 Amax, 1982
3) Wesfrob (closed)	Fe/Cu	Some*	+
4) Yreka (closed)	Cu	None	+
5) Texada (closed)	Fe	Some	+
6) Jordan River (closed)	Cu	Some*	Ellis and Popham, 1983
7) Brynnor (closed)	Fe	Some, after closure	+
8) Britannia (closed)	Cu	Some*	Ellis and Popham, 1983
9) Polaris	Pb/Zn	Some	+
10) Nanisivik	Pb/Zn	Pre-operational* Some later	+ (chose lake disposal) Thomas and Metikosh, 1984 Fallis, 1982
11) Kitimat (smelter)	Al	Some	Hocking et al., 1980
U.S.A.			
12) Quartz Hill (under development)	Mo	Extensive*	USDA, 1984
GREENLAND			
13) Black Angel	Pb/Zn	Extensive*	+
NORWAY			
14) Fosdalens Bergverk	Fe	Some	+

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Table 1 cont...

Mine	Main Product	Environmental Impact Assessment	Introductory References
15) Repparfjord	Cu	Some	+
16) Stjernoy	Fe	Not known	+
17) Ranafjord	Fe	Some	NIVA, 1977
U.K.			
18) Cleveland Potash	Potash	Some	+
19) Hayle Estuary	Sn/Cu	Some, after closure*	+
MEDITERRANEAN			
20) Pechiney	Al	Not known	+
21) Pennaroya	Pb/Zn/Fe	Not known	+ Down and Mill, 1978
RED SEA			
22) Atlantis Deep	Zn/Cu/Ag	Extensive	Mustafa and Amann, 1980 Fletcher and Mustafa, 1980
MALAYSIA/THAILAND			
23) Bhuket/Aokam	Sn	Not known	-
24) Bhuket/Tongkah	Sn	Not known	-
25) Billiton	Sn	Not known	-
26) Ma On Shan	Fe	Not known*	+
PHILLIPINES			
27) Marcopper	Cu	Some*	+
28) Atlas	Cu	Some*	+ Alino, 1984
PAPUA NEW GUINEA			
29) Bougainville	Cu	Extensive*	+ Powell et al., 1981

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Table 1 cont...

Mine	Main Product	Environmental Impact Assessment	Introductory References
AUSTRALIA			
30) Yabulu (refinery)	Ni	Some*	+
31) Tasmania (waste dumps)	Au	Some*	Ratkowsky et al., 1974 Ayling, 1974
CHILE			
32) El Salvador	Cu	Some	Castilla, 1983

*Metal data available.

+See Poling, 1982, for bibliography on most mines listed.

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Table 2. List of species tested for tissue metal levels at various mine sites.

Mine Sites	Years of Observations
ISLAND COPPER (As, Cd, Cu, Hg, Mo, Zn, Pb)	
Plants	
Fucus distichus, rockweed	1976 annually
Zostera sp., eelgrass	1978 annually
Zooplankton	
total)	1972 annually
euphausids)	1975 annually
Shrimp	1975 annually
Cancer magister, Dungeness crab	1971 annually
Bivalve molluscs	
Mya arenaria, soft-shelled clam	1971 annually
Protothaca staminea, littleneck clam	1971 annually
Macoma irus	1975 annually
Mytilus edulis, blue mussel	1974 annually
Humiliaria kennerlyii (a deep water clam growing on tailings beds)	1977 annually
Saxidomus giganteus, butter clam	1971 annually
Fish	
Many species	1971 annually to 1976
KITSAULT (Cu, Cd, Fe, Zn, As, Mo, Ni, Cr, Pb, Hg, Al)	
Plants	
Fucus distichus, rockweed	1977, 1978, 1981
Shrimp	
Several species (analysed separately)	1978, 1980, 1981
Crab	
Lithodes aequispina	1978, 1980, 1981
Chionoecetes bairdi	1980, 1981
Bivalve molluscs	
Mytilus edulis, blue mussel	1977, 1978, 1981
Yoldia thraciaeformis/montereyenis	1978, 1981
Clinocardium, cockles - 2 species	

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Table 2 cont...

Mine Sites	Years of Observations
Fish	1980, 1981
Sole, several species (analysed separately)	
KITIMAT (F)	
Fucus distichus	1976
Ectocarpus sp.	1976
Balanus glandulosa?	1976
Macoma inconspicua	1976
NANISIVIK (As, Zn, Cd, Fe, Cu, Pb, Hg, Mn)	
Mya truncata	1975, 1979, 1982
Boreogadus saida	1974-1975 baseline
Zooplankton	1974-1975 baseline
Fucus vesiculosus	1974, 1976, 1979
Strongylocentrotus droebachiensis	1979
Laminaria solidungula	1976, 1979
Agarum cribrosum	1979
Myoxocephalus quadricorni	1979
Myoxocephalus scorpioides	1979
Leptasterias polaris	1979
Serripes groenlandicus	1975, 1979
Cardium ciliatum	1975, 1979
Holothuria	1979
Palmaria palmata	1976
Astarte boreali	1975
Modiolaria nigra	1975
Hiatella arctica	1975, 1979
Buccinum - 3 spp.	1978
Sipho	1975
BOUGAINVILLE (Cu, Pb, Zn, Cd, Hg, As, Mo)	
Many fish species [8 reported in Powell et al., (1981)]	Several years

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Table 2 cont...

Mine Sites	Years of Observations
TASMANIA (Zn, Cd, Cu, Cr, Pb)	
Crassostrea gigas, Pacific oyster	1973
WESFROB (Fe, Pb, Zn, As, Cd, Ni, Hg)	
Bivalve mollusca	
Haliotis kamskatchana, abalone	1971-1974?
Mytilus edulis, mussel	1971-1974?
Hinnites, rock scallop	1971-1974?
+ others intermittently	
JORDAN RIVER (Cu, Zn, Cr, Cd, Pb, Ag)	
Protothaca staminea, littleneck clam	1972-1978
+ others initially	
BRITANNIA BEACH (Cu, Zn, by x-ray energy spectroscopy)	
Mytilus edulis, mussel	1980
Protothaca staminea, littleneck clam	1980
Macoma baltica	1980
Plants	
Fucus, rockweed	1980
Ulva, sea lettuce	1980
Laminaria, kelp	1980
BLACK ANGEL (Zn, Pb, Cu, Cd, Ni, Ag, Fe)	
Fish	
Anarrhicas minor, wolf fish	1973-1977
Platysomatichtys hippoglossoides, halibut	1973, 1974
Mytilus edulis, mussel	1972, 1973, 1976
Fucus spp, rockweed	1972, 1973, 1976

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the years, i.e. fish were dropped, bivalve species changed, and some crustacea and marine plants introduced.

RESULTS

Table 3 provides a summary of elevated tissue metal levels detected at the well investigated sites. Some algae and some bivalves show elevations of some metals at some sites. Comments from the originating reports are paraphrased, and the metal data is given in the various formats reported.

DISCUSSION

The range of species tested

At sites where a range of species has been tested such as at Island Copper, Kitsault and Nanisivik, we should consider whether the species are representative samples of the biological communities. Almost certainly they are not, in spite of the number of species tested, and equally it is probably impossible to get such a representative sample without stratifying sampling in some way. Marine benthic fish and plankton communities are highly diverse and variable (for B.C. benthos as an example see Levings et al., 1983 and Ellis, 1969 and 1971, and for arctic benthos see Ellis, 1960). The Island Copper initiative of changing the original species tested reflects a real world situation that only some species are suitable for tissue metal monitoring and toxicological research. These species must be large enough for tissue extraction, abundant, slow moving nr sessile for easy collection, consistently available from sampling to sampling, and preferably do not take up inorganic particles with biologically unavailable metal. The species-year list from Nanisivik and Kitsault (Table 2) shows how inconsistent survey collections can be. Some method of sampling species in a relevant and consistent stratification is needed.

From the point of answering the vital question whether there is toxicological damage to resources and public health, the only reasonable stratification is to sample the various ecosystem compartments through which metals will flow. A model of such compartments at which metal determinations and level of impact can be made is given in Table 4. Measures of concentrations and total amounts in the various compartments then allows a bookkeeping approach to metal flow determining how much of the total input has gone into low level sinks, how much is dispersed harmlessly and exported by water currents, plankton or migratory animals, how much is moving up the food network, reducing in concentration as it goes (see Black Angel wolf-fish, Table 3), how much is moving up a food chain and biomagnifying, what is the final compartment sink for such biomagnified metals, at what stage does resource impact occur, and whether public health is at risk.

The ecologist's approach is obviously a complicated, time-consuming and costly procedure. Fortunately there are other ways of achieving equivalent levels of resource protection.

The potential for biomagnification

The reported metal results summarized in Table 3 give no indication that

Table 3. Mines and species with elevated levels of metals in a spatial or temporal pattern suggesting bioaccumulation from mine wastes. Mg/kg dry weight unless otherwise shown.

Mine Sites			Notes
ISLAND COPPER+			
Fucus, rockweed	Cu	50-60	)
	Zn	30-100	) May be attached particles
	Cd	4.0-4.5	)
Mytilus edulis, mussel	Cu	2	Consistently higher at loading dock than reference docks (Cu = 1.5) but no trend to increase
	Zn	35	
KITSAULT			
Yoldia	Pb	200-300	1981 increase from 10-50 in 1978
	Cd	30-35	1981 increase from 18-20 in 1978
			Deposit feeding small species
			Not always available
			Highly variable results
			No size related data
WESFROB			
	None		
JORDAN RIVER			
Protothaca staminea, littleneck clam	Cu	20-30	About double reference specimens
BRITANNIA BEACH			
Mytilus edulis, mussel	Cu	645	Viscera
	Zn	607	Gill
Protothaca staminea littleneck clam	Cu	119	Viscera
	Zn	100	Viscera
Macoma baltica	Cu	160	Gill
	Zn	448	Viscera

Table 3 cont...

Mine Sites			Notes
Britannia Beach cont...			
Plants			
Fucus, rockweed	Cu	111	
Ulva, sea lettuce	Cu	345	
	Zn	218	
BLACK ANGEL (Pb is wet weight)			
Fucus, rockweed	Zn	20-100 (1977)	Zn generally increased from 1973
	Zn	100-500 (1974)	to 1974 after discharge started
	Pb	40-50 (1977)	Pb increased from ≈ 10 in 1973
Mytilus edulis, mussel	Zn	40-70 (1974)	Zn generally increased from 1973
	Zn	100-550 (1977)	to 1974 after discharge started
	Pb	40-50 (1977)	Pb increased from ≈ 10 in 1973
Wolf-fish liver	Pb	2.5	Predator
KITIMAT			
Ectocarpus	F	317	Higher at 150 m from outfall than at 500 m
Amphipods	F	1168	Higher in amphipods than in barnacles or bivalves (Macoma)
NANISIVIK			
Mya truncata	Pb	5.4	No biochemical impact
	Zn	584	No obvious pathologies (histological examination)
			Exceed maximum levels for marine products
Fucus vesiculosus	Pb	28.3	Increased
	Zn	x 5.6	
	Cd	?	
	As	x 1.4	
Strongylocentrotus droebachiensis	Pb	23.9	Increased
	Zn	x 4.3	
	As	x 1.1	

Table 3 cont...

Mine Sites		Notes
Nanisivik cont...		
Serripes groenlandica	Pb x 19.7 Zn x 2.3 Cd x 1.9 As x 1.7 Hg x 4.7	
Cardium ciliatum	Pb x 1.4 Zn x 1.7 Cd x 2.4 As x 1.7 Hg x 2.2	

*Range approximated from diagrams, 1983 data.

Table 4. Measurement points in the flow of metals through an ecosystem.

Measurement Points	Notes
1) Effluent (tailings)	Total and biologically available metal measures needed for all relevant trace metals
2) Turbidity field	
3) Water column	
4) Sediments	
5) Interstitial water	
6) Whole organisms	Tissues homogenized Includes unmetabolized metals
7) Organism tissues	Metals present may be detoxified (sequestered), e.g. metallothioneins, shells X-ray microanalysis to distinguish between metabolized and unmetabolized metal
8) Organism pathologies	Correlations needed with tissue metal sites; intercellular and intracellular
9) Stock losses (nos. organisms)	Correlations needed with extent of pathologies
10) High trophic levels	Food chain routes need determination May be biomagnification or bioreduction
11) Public health measures (human measures)	If cause for concern

biomagnification occurs at marine discharging mines. However, the lack of indication is in part due to difficulties of appropriate sampling. There are two alternatives to simple metal analyses which can support an appraisal of biomagnification risk.

A resource inventory and appraisal of resource use can show whether the upper level ecosystem compartments of biological resources and humans near the waste receiving area are at the end of an almost closed food chain, from which potentially bioaccumulating metals cannot escape but will be channelled upward. If a proposed receiving area is occupied by a population of fishermen drawing for subsistence on bioaccumulating species, or if commercially fished stocks of predators or suspension feeding shellfish are present, then there are reasons for social concern and action. If the discharge is nevertheless permitted on the grounds of improbable risk, a monitoring programme of the socially important food chain should be required.

A second approach to appraising the likelihood of biomagnifications is use of the Ca-K ratio analysis developed by Young (1982). He showed that in the Californian inland salt lake, the Salton Sea, food chains of phytoplankton to striped mullet, and the detritus feeding polychaete Neanthes succinea to two fish species and then to a top level carnivorous fish, gave high ratio values for fish muscle. Young predicts that the Ca-K ratio is a simple test that, applied to resource species, can indicate the possibility of biomagnification. The ratio needs wider testing as a useful indicator of risk, and the most appropriate monitoring.

Where resources are considered to require monitoring, simple testing of metal levels in tissues is insufficient, since such monitoring does nothing to appraise impact. What is needed is development of studies initiated at Nanisivik in 1982, where a start has been made on relating metal levels to pathology (Thomas and Metikosh, 1984).

Bioavailability of toxins

There is a widespread opinion that animal specimens collected for tissue metal determinations should be depurated of inorganic particles which can bear component or adsorbed trace metals not biologically available to living organisms. Collected algae and eelgrasses at Island Copper mine have also been checked by scanning electron microscopy; it is suspected that inorganic particles can adhere to the rockweed Fucus particularly, and be resistant to cleaning. In this context the problem for field studies is the degree in which inorganic particles lower the precision of the metal analyses, and possibly the accuracy also (depending on what the investigator thinks he or she is investigating, e.g. total, metabolized or sequestered metals). Lack of precision comes from many factors including amount of attached particles, varying concentrations of component and adsorbed metals, the extent to which animals feeding on particle-carrying organisms may be able to digest the metals present and finally, the extent to which depuration and cleaning is incomplete.

The resolution to the problem is to use species which do not require extreme cleaning or depuration procedures, unless there are no alternatives. In this context, slime-producing algae such as the rockweed Fucus, and deposit-feeding bivalve molluscs such as species of the genera Macoma (Reid and

Reid, 1969) and Yoldia (Stasek, 1965 and Drew, 1899) are suspect. Mussels and oysters as accessible shellfish with known ability to bioaccumulate are preferred species, as are benthic feeding resource species such as crustacean shellfish, flatfish and codfish.

CONCLUSIONS

The following tentative answers can now be given to the three questions set in the introduction:

[1] There is very little evidence to date that at marine discharging mines, trace metals do more than bioaccumulate at single trophic levels. If they do flow to higher levels, their concentration reduces and does not biomagnify. In other words, such trace metals appear to be entering low level ecosystem sinks, such as thick layers of tailings deposits, or they disperse at low and harmless concentrations through the ecosystem by currents, plankton or migrants.

[2] Few sites have accumulated trace metals in biological sinks and to levels where contaminated specimens are consistently available to toxicologists for field appraisal of the relevance of their laboratory investigations to social problems. Of these the Black Angel mine in Greenland and the Nanisivik site in Baffin Island appear to provide reasonable opportunities for field investigations.

[3] The important toxicological research needed for ecosystem analysis consists of interdisciplinary studies of trace metal bioavailability, biolocation at inter- and intracellular levels by electron microscopy and x-ray microanalysis, pathology correlations, and resource impact.

In addition, the case history data indicates that improved toxicological impact assessment can be brought about by rational selection of resource species, and a limited range of other species, for tissue metal and pathology measures.

ACKNOWLEDGMENTS

My thanks go to Ms. Gretchen Moyer for word-processing, and to many colleagues who have discussed my ideas with me and criticized them over the years.

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57

GREENS CREEK MINING CO.
a division of AMSELCO MINERALS INC.

9000 Glacier Highway
P.O. Box 32277
Juneau, Alaska 99803
Telephone (907) 789-4171
Facsimile (907) 789-7112

RECEIVED
MAY 26 '87
FOREST SUPERVISORS OFFICE

10/V 6.3.0

May 18, 1987

Mr. Win Green
Forest Supervisor
Forest Service
USDA
Federal Building
Ketchikan, Alaska 99901

SUB: U.S. Borax Quartz Hill - Revised EIS - Draft

Dear Mr. Green:

The Greens Creek Mining Company supports the decision of the U.S. Forest Service in its selection of Wilson Arm as the disposal site for tailings from the U.S. Borax Quartz Hill molybdenum project.

The amount and degree of the environmental studies that have been performed by U.S. Borax to evaluate and determine the impact of tailings disposal between the two disposal sites Wilson Arm and Boca de Quadra, is staggering. The environmental impacts have been very clearly identified and quantified as being minimal. However the $59 million capital cost and $1.6 million operating expense which will be eliminated by using Wilson Arm as the disposal site cannot be ignored. U.S. Borax should not be penalized by the 55 cent per pound additional cost to produce molybdenum in order to provide the very marginal extra environmental safety afforded by the greater depth of Boca de Quadra.

Mining of molybdenum is a very competitive business and obviously very sensitive to metal prices. The additional cost to produce a pound of molybdenum by using the Boca de Quadra site could seriously delay the startup of this project and all the economic benefits that will be forthcoming when Quartz Hill begins production.

#1

EPA must weigh all environmental factors when making its decision between the two disposal sites. The agency cannot ignore the issues of confining mine development to a single drainage or the construction of facilities for tailings disposal in a designated wilderness area with the resulting impacts.

57

The U.S. Forest Service has made the correct decision contained in the Revised EIS Draft for the Quarts Hill Project, by selecting Wilson Arm for tailings disposal. Their selection results in the least environmental impact and also allows for a very significant cost savings to the project.

Thank you for the opportunity to comment.

Sincerely,

J. P. Bingham

J. P. Bingham

PWR/rkb
cc P. W. Richardson

58

M. A. HANNA COMPANY
RESEARCH CENTER
P.O. BOX 67
NASHWAUK, MINNESOTA 55769
(AREA CODE 218) 885-1951

RECEIVED
MAY 26 '87
FOREST SUPERVISORS OFFICE

May 19, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The M. A. Hanna Research Center would like to go on record in supporting of U.S. Borax's Quartz Hill Project. We are convinced that the project is engineered on sound environmental, engineering, and economic principles that will benefit Alaska and our country for many years to come.

We are in a position to make the above statement as we had the opportunity of working with U.S. Borax Research in the development of the process flowsheet which we piloted. They are extremely thorough and "left no rock unturned".

We believe U.S. Borax has developed an environmentally sound project in an economically secure manner to produce a "win-win" project for everyone. Therefore, we recommend the project proceed.

Sincerely,

M. A. HANNA COMPANY RESEARCH CENTER

R. A. Wickman, Manager
Research & Development

RAW/nsj

cc: R. S. Burd
W. Gregory
B. Grogan
P. J. Brotherton

59

THOMAS M. CROMWELL
1514 Park Somerset Drive
Lancaster, CA. 93534

May 20, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK. 99901

Dear Mr. Green:

This letter is written in support of the Quartz Hill project located in southeastern Alaska and owned by U.S.Borax.

It is my conviction that this project would be in the best interest of the United States and Alaska, and therfore should be granted the necessary permits for development and operation.

It is also my view that the mill tailings should be disposed of in the Wilson Arm as recommended in the U.S. Forest Service Revised Draft EIS.

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Very truly yours,

Thomas M. Cromwell

60

Mr Win Green, Forest Supervisor
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

5-20-1987

From: Jackie E. Stephens
P.O. Box 9
Liberty Lake, Wa 99219

Regarding: The Draft EIS on the Quartz Hill Molybdenum Project

Dear Mr Green:

The U.S. Forest Service and the State of Alaska personnel associated with the Quartz Hill EIS should be highly complimented for their continued support on the Quartz Hill Project. It certainly has been a long hard uphill costly battle. I as a citizen and a geologist would like to thank you for your supporting this major future mining effort.

A lot of money (profits from U.S. Borax) has been sunk into this mining effort, and a lot more will be needed before the mine becomes a working reality. It has been mentioned that U.S. Borax has spent $100,000,000 on the Quartz Hill Project to present, since its discovery in 1974. It should be noted that most of this $100,000,000 was spent more than five years ago. Therefore, the dollar figure for money spent on the project is significantly understated in todays dollars or present worth dollars. To justly calculate the "PRESENT WORTH DOLLARS" (see Frank Stermole's: Economic Evaluation and Investment Decision Methods, 6th edition, May, 1987) of Borax's investment to present, requires the application of at least a 15% DCFROR interest compounded annually to the $100,000,000 invested. This would calculate out over the last five years to present to be $201,135,710 (present worth of dollars spent), not to mention the research and exploration dollars that went into the discovery before 1974, and the significant amount of dollars spent just after the discovery lobbying to save the project from total obstructionistic disaster. This 15% ROR would be a minimum expected return for any average industrial investment, with an average risk. To have $100,000,000 tied up over this long a period of time with no return might have to be considered a loan or subsidy to the Alaskan and United States economy. It certainly makes little financial sense, unless the company has exact visions of tremendous future returns on its money. Obviously the company feels very strong about its commitment to mine at Quartz Hill.

The USFS and the State of Alaska can certainly help in ascertaining the minimizing future delays of the project by lending support for the logical developement of the project. The logical developement of the project will save money and possibly the project. A key issue in the Revised Draft EIS is the preferred alternative for tailings disposal. The DEIS states: "THE FOREST SERVICE PREFERRED ALTERNATIVE FOR TAILINGS DISPOSAL IS MARINE DISPOSAL IN THE WILSON ARM WITH APPROPRIATE MITIGATION, THERE IS LITTLE DIFFERENCE IN THE ENVIRONMENTAL EFFECTS OF TAILINGS DISPOSAL IN THE MARINE ENVIRONMENT BETWEEN THE WILSON ARM AND BOCA DE QUADRE FIORDS." This is without any doubt the most environmentally sane choice for tailings emplacement. Your continued support and interest in the developement is greatly warranted and appreciated. Thank you.

Sincerely,

Jackie E. Stephens

Jackie E. Stephens

61

510 S. NORMADIE AVE. 204
LOS ANGELES, CA 90020

May 21, 1987.

Dear Mr. Green:

For some time I have been interested in the molybdenum project at Quartz Hill. It seems a great opportunity to tap the riches of fabled Alaska.

The proposed tailings disposal at Wilson Arm/Smeaton Bay covers quite adequately concern for the environment. The developing company, U.S. Borax, should be assisted and encouraged in every way possible to move ahead on this exciting new horizon of such fine promise.

Sincerely,

Mary D. Crunican

Copy to:
U.S. Environmental Protection Agency, Seattle
U.S. Army Corps of Engineers, Anchorage
Office of the Governor, Alaska, Juneau

62

Patricia L. Bates

Los Feliz Towers, Suite 506, 4455 Los Feliz Boulevard
Los Angeles, California 90027

May 21, 1987

Mr. Win Green, Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

Re: U.S.BORAX
QUARTZ HILL MOLYBDENUM PROJECT

Strategic metals are essential to the United States and molybdenum is one of the metals required to produce various alloys critical to our nation. U.S. needs a domestic supply and Alaska needs the revenue that the Quartz Hill project could supply if the Government agencies, both State and Federal, would support the permitting of the project to keep it economically viable.

The Wilson Arm alternate should be approved as the tailings disposal site as indicated in a study made by U.S.Borax in their research during the last ten or twelve years.

I have followed this project for years and believe that Alaska is lucky U.S.Borax made this significant discovery of molybdenum at Quartz Hill and that they have been so environmentally careful at each step of development.

This project could, if permitted, have a tremendous impact on Alaska's economy by creating a multitude of jobs.

Your support for the Wilson Arm disposal site would be for the good of all of the citizens in Alaska and would perhaps make the difference between "go" and "no go" to the developer. Your support is sincerely requested.

Yours truly,

Patricia L. Bates

Patricia L. Bates
cc:
Mr. Robert S. Burd, EPA, Seattle
Col. Wilbur Gregory, Corps of Engineers, Anchorage
Mr. Bob Grogan, Office of the Governor, Juneau

USDA FOREST SERVICE
KETCHIKAN AREA
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63

HARTCROWSER

May 21, 1987

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FOREST SUPERVISORS OFFICE

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

On behalf of Hart Crowser, Inc., an earth and environmental technologies consulting firm based in Anchorage and Seattle, we wish to express our firm's support of the Quartz Hill molybdenum project.

Our involvement with the project has included provision of geotechnical exploration and design studies as well as cultural resource services in which field surveys were conducted, project impacts determined and mitigative measures recommended.

Throughout our work with U.S. Borax on the Quartz Hill project, it has been our experience that the project's effects upon the environment have been carefully assessed and that steps have been taken to minimize the project's disruption of the environment.

In light of the project's considerable potential economic value to the region, and U.S. Borax's determination to conduct the project utilizing responsible engineering and environmental practices, we feel this project should receive the support and encouragement of state and federal agencies under whose jurisdiction the project lies.

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Quartz Hill Project
Page 2

If you would like additional information about our experience with the Quartz Hill molybdenum project, please contact our firm.

Sincerely,

HART CROWSER, INC.

Peter M. Douglass

PETER M. DOUGLASS, P.E.
Vice President

JAMES D. GILL, P.E.
Alaska Manager

cc: Mr. Robert S. Burd, U.S. Environmental Protection Agency
Colonel Wilbur Gregory, U.S. Army Corpa of Engineera
Mr. Bob Grogan, Alaska Division of Governmental Coordination

64

Virginia Klepser
1108 Dunton
Ketchikan, AK 99901
May 21, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The forthcoming decisions that will be made concerning Quartz Hill are of vital importance to every person, directly living in Southern Southeast Alaska and indirectly to those in rest of the state.

One of the basic problems to having a viable economy in Southern Southeast is the number of jobs that by their nature and definition are seasonal. Full-time, year around employment by a few major industries could be an offsetting factor with the potential to smooth out our current fluxuating economy. The pulp mills operating year around over the past year has been a major factor in keeping other aspects of the economy rolling, add Borax with its potential for year around employment, well, the affect cannot be overstated.

Being a member of a commercial fishing family, my concerns are always for the enhancement of the fish stocks. While we are assured that fish stocks will not be affected, should something go awry, the Wilson Arm option is by far the more favorable to the rank and file commercial fisherman from opinions expressed in our home. This is also the option that makes Quartz Hill a more viable financial possibility.

As a long time Alaskan with strong concerns for Alaska's environment, use of its natural resources and its people, I strongly support the Borax position with tailings going into the Wilson Arm Fjord.

Sincerely,

Virginia Klepser

Virginia Klepser

cc: Mr. Robert S. Burd
Col. Wilbur Gregoryff
Mr. Bob Grogan

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65

Performance Associates, Inc.

P.O. Box 6000-410
Danville, California 94526
Telephone (415) 838-7464
Telex 337-717 HOMEOFCDVL

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May 21, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

Several years ago, as a manager of the Bechtel Corporation's Mine and Plant Operations group, it was my good fortune to work with U.S. Borax on their Quartz Hill project. At that time, it was apparent that environmental concerns were as critical to U.S. Borax management as they were to the various environmental agencies.

As a result of the exhaustive studies which took place during that period of time I became convinced, as I still am, that the selection of Wilson Arm/Smeaton Bay as the tailings disposal site for the project will have no more effect upon the marine environment than would the selection of the Boca de Quadra fjord. In addition, the construction of tailings facilities in a designated wilderness area, which would be necessary if the Boca de Quadra fjord were selected as the tailings disposal site, would be ludicrous in light of the marginal extra safety afforded by the greater depth of that fjord.

I further believe that if public support for environmental concerns is to remain a viable force, then those responsible for establishing environmental policy must recognize that the vast majority of U.S. citizens want to minimize environmental impact, while continuing to encourage economic growth. This project meets those criteria.

Currently, as chairman of a management consulting firm doing business on a world wide basis in mining, I can assure you that unless our environmental policies and decisions become more pragmatic and realistic, we will continue to decline as an industrial power. For that reason, as well as those mentioned earlier, I believe that the Quartz Hill project, as proposed by U.S. Borax should receive your support and immediate approval.

Very truly yours,

Bill Hoffman

C. W. Hoffman
Chairman

MINFBD.CWH 3

66

8424 Viburnum
Calif. City, CA 93505
May 21, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Ketchikan, AK 99901

re: US Borax Quartz Hill Project

Dear Sir:

I am writing you regarding this project as I am convinced that there is a determined effort to make this mine so expensive that it will never be possible.

The efficient use of resources is a must if mankind is to continue to prosper. When we lock a resource up, we deprive people of the use of it. Minerals deposits are not like a building that can be located to suite the builder. Like it or not, we have to utilize them where ever we find them.

I am in favor of allowing tailings disposal in Wilson Arm/Smeaton Bay.

I am in favor of allowing U.S. Borax to receive the necessary permits to go forward in the development of this mine.

Sincerely,

Gerald L. Moseley

Gerald L. Moseley

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67

Mountain View Trailer Court & Sales

P. O. Box 2327 -:- Ketchikan, Alaska 99901

Jay and Stella Beth Coon, Owners

907 CA5-4707

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MAY 26 '87
FOREST SUPERVISORS OFFICE
FS, DFS, PLN, PAS, AO, I.M., ENG, F&W, M&WS, R&L

Mr. Win Green, Forest Superviser
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska

Dear Mr. Green:

This is a positive letter for the Quartz hill project. This is one of the best things that could happen to this part of Alaska, Its time that we give encouragement to industries such as this.

I believe that the environment controls should be looked at, but people and jobs are much more important. As I understand the fish stream will be protected, whats the fuss?

I also fish commercially, but I don't think that all the fish in the S.E. comes from that area.

Our Families need jobs, and this means better living conditions, gives our people self esteem. With the oil prices down, and the taxes coming up, and the state crying about how they can operate the state, lets do something constructive to bring new money into Alaska.

Very Sincerely,

Jay E. Coon

Jay E. Coon-Owner-Mt. View Trailer Court
Owner- F/V Northern Star

68

EFHutton

E.F Hutton & Company Inc 888 W Sixth St, Los Angeles, Calif. 90017 (213) 488-3591

Gordon B Crary, Jr.
Executive Vice President

May 18, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK. 99901

Dear Mr. Green:

I am an outside ("non-employee") director of U. S. Borax and Chemical Company. Even though I have no ownership interest in the company I am willing to serve on its board because the company is first class in all respects. The firm with which I am affiliated has no current business relationship with U. S. Borax; they did however, have a relationship about ten years ago when some bonds were underwritten and would like to have one.

U. S. Borax is operated with long term objectives rather than the "spend as little and take as much as you can while it lasts" philosophy which is so damaging to people, environment and country. U. S. Borax is a good corporate citizen.

I am writing you to urge approval of the U. S. Borax plan for the Quartz Hill project near Ketchican. The project must be a low cost producer to be economically viable and thereby create jobs both directly and indirectly. The environmental regulations and controls must be balanced to allow the project to be economically viable.

U. S. Borax is responsible and responsive, they will do their very best to manage this project correctly, in a manner that we can all live with over the long pull of many years to come.

Thank you for your consideration.

Sincerely,

Gordon B. Crary, Jr.

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FOREST SUPERVISORS OFFICE

69

ASCC

ALASKA STATE CHAMBER OF COMMERCE

310 Second Street
Juneau, Alaska 99801
(907) 586-2323

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MAY 22 '87
FOREST SUPERVISORS OFFICE

May 19, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The Alaska State Chamber of Commerce is writing to give our response to the reissue of the Draft Environmental Impact Statement (RDEIS) for the U.S. Borax Quartz Hill Project. ASCC is a statewide organization representing approximately 1,000 businesses in Alaska.

We have reviewed the RDEIS and the alternatives displayed and give our overwhelming support to your choice of Wilson Arm as the preferred alternative. We believe the Wilson Arm alternative is the best balance of the environmental and socioeconomic values. We believe the small differences in the environmental values in the two fjords cannot offset the importance of the economic viability of the project. Certainly the ANILCA requirements for protection of the fisheries and the monitoring that will accompany the permitting process provide ample protection for the environmental values.

We also believe there are aesthetic advantages to Misty Fjords National Monument in restricting the activity to only one fjord and not having to encroach on the wilderness area in Boca de Quadra.

Alaska needs to develop its mineral resources to supplement and diversify its total dependence on oil. With reasonable protection for the environment, the Quartz Hill Project should be given the best possible economic opportunity for development and the strongest possible competitive position in the world's molybdenum markets. This can be accomplished by allowing them to place their tailings in the Wilson Arm fjord.

Thank you for permitting us to comment on this project which can be an important addition to the Alaskan economy.

Cordially,

George Krusz
President

GK:hlh

~~No Return Address~~

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Mr. Win Green

U.S.Forest Service

I do not want U.S. Borax to build the mine in Misty Fjords. Here are my reasons: 1) It is not a renewable resource, and tourism is. What tourist will be interested in looking at a mess in the middle of a Wilderness area?
2) Molybdenum, while a useful element, is not used in great proportion in the manufactoring of alloys. The signifigance of the current low price of molybdenum on the world market is a reflection of supply and demand. There is not that great of a demand, and there are many molybdenum mines already in existence to supply demand. In fact, mines in British Columbia and Nevada have closed because the supply is greater than the demand, and the price of molybdenum makes mining it economically unfeasible.
3) US Borax is so profit minded that it is willing to dump tailings into viable fish-producing areas, another renewable resource, in order to make a profit. As already pointed out, molybdenum is a marginally economically feasible element to begin with, so US Borax is forced to find the cheapest way to mine it. Unfortunately this means polluting the waters in order to make a profit.
4) There is little remaining wilderness in the world, and the value of allowing future generations the chance to experience it by far out weighs US Borax's short-term profit goals.

5) Please factor in the fact that the number of letters you get in support of the mine is in direct correlation to the number of propaganda ads placed in the Ketchikan Daily News recently by US Borax, and that a majority of them, no doubt, supported the short-sighted decision to dump the tailings in the pristine waters.

Thank you for taking these findings into consideration.

[illegible]

71

USIBELLI COAL MINE, INC.

P.O. Box 1000
Healy, Alaska
99743

USDA FOREST SERVICE
KETCHIKAN AREA
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MAY 22 '87
FOREST SUPERVISORS OFFICE

20 May 1987

Mr. Win Green - FOREST SUPERVISOR
Forest Service - South Tongass District
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

We would like to voice our support of your recent revised draft environmental impact statement which selected the Wilson Arm - Smeaton Bay area as the preferred alternative for tailings disposal. Your scenario takes into account all the important issues ranging from the social and economic future of Alaska, to mitigation of any perceived harm that could be demonstrated regarding marine environment.

It should always be the obligation of agencies both at the state and federal level to assure that reasonable environmental controls are applied to the type of major mineral development U.S. Borax is proposing. Reasonable must be interpreted as balancing both environmental and economic considerations that are represented in the EIS process. The EPA's preferred alternative is speculating risk to a small amount of salmon, and the Boca de Quadra basin does not insure any measurable protection over the Wilson Arm area. What is measurable however is an additional capital cost for operation and maintenance that exceeds 100 million dollars.

#1

Alaska needs projects such as Quartz Hill to become a reality if we are to diversify the economy and develop our potential in the mineral market place. The amount of funds already invested demonstrates a commitment to bring this project from the conceptual to the operational phase. Now is the time to hold the line on the preferred alternatives you have selected if we truly want to gain the benefits that this project represents.

Sincerely,

Joseph E. Usibelli
PRESIDENT

CC: Mr. Robert Burd - U.S. EPA
Colonel Gregory - U.S. Army Corp of Engineers
Mr. Bob Grogan - Office of the Governor

72

Ridgewood Mobile Home
Park & Sales
R C Enterprises
Rt. 1 Box 523A
Ketchikan, Alaska 99901
(907) 225-4813

5/21/87

USDA FOREST SERVICE
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FOREST SUPERVISORS OFFICE

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green et al:

We wish to submit our sunport for the Quartz Hill Moly. Project and the tailings disposal in Wison Arm/Smeaton Bay.

To qualify our position we submit the following:

A) Wife, Rosemary, born in Ketchikan.
   1) continuous resident with the exception of a 2½ year absence 1948 to mid 1951.

B) Husband, Robert, resident since 1944.
   1) Same abscence 1948 to mid 1951.

C) We have been involved during the past 40 years in Alaska. Primarily Ketchikan area in---
   1) logging
   2) Commercial fishing
   3) sport fishing
   4) hunting
   5) boating
   6) tourism
   7) automotive business
   8) sales
   9) construction
   10) landlord

Our usage of the outdoors and Alaska's resources have been in moderation and with respect, void of waste and destruction.

We feel we are average Alaskan's and perhaps "PRACTICE" ecology and conservation more than those who choose to protest any and all develope-ment.

We have purposefully emphasized "PRACTICE" as in our tenure we have witnessed and read of those who have involved themselves with ecology ect. Yet have violated and misused our resources.

We have attended hearings and witnessed testimony that were in some cases outright lies, but in the most part erroneous and slanted to accomadate a particular scenario.

In brief I call your attention to the Ketchikan Pulp Mill proceedings and the testimony presented as to the "terrible destruction of salmon, crab, etc. in Ward Cove". Why are the fish still evident in Ward Cove, Ward Lake, and Ward Creek? Not to mention crab and other sea life.

Ridgewood Mobile Home
Park & Sales
R C Enterprises
Rt. 1 Box 523A
Ketchikan, Alaska 99901
(907) 225-4813

If there has been damage or depletion of stocks I have not seen the proof.

I also point to Prudhoe Bay, the oil pipeline, Valdez, etc., etc., that have been developed without any disastarous adverse effects as speculated. The cariboo herds have populated and increased since the oil developement, fish runs have been on the increase over the years in conjunction with logging and mining. We have been continuously at the mercy of those who can only protest as to "surmising" and "speculating" on adverse damage. Those who develop that cause enviromental damage are continuously monitered and fined for violations and/or damage.

May I suggest that those who only speculate and provide no concrete evidence, but deter or stop developement to the point of costing multi dollars be required to be responsible for their actions to those damaged.

This has an adverse effect on our economy and way of like that crys out for dual responsibility and liability.

The tax payer has been supporting and paying the bill for all the "speculative" protesting for too long. We are in need of returns from those inestments and a sharing of equal responsibilities and liabilities.

The public must rely on thepeople we have employed to rationalize and sift out the facts and conditions for the protection of the ecology and environment and the true and just consideration to developement and void of bias for bias sake and political pressure.

We feel U.S. Borax has gone "The Extra Mile" in their studies and reports and have provided adequate assurance of protection and if approved they will continue to be accountable.

We realize our support lends nothing to the technical aspect of the project, but we are not trained technichans in the project area, however neither are many of the opposition even though some make the attempt.

We have chosen to support the project feeling a vast amount of protection to insure aminimum of ecology impacts has been provided.

We also chose to present our views in the areas of equal liablity and responsibility as an important dimension that demands serious consideration.

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Ketchikan, Alaska 99901
(907) 225-4813

We further believe strongly in the multiple use concept for the benefit of all.

Thank you for the opportunity to comment and your consideration.

Sincerely,

Robert C. Crowder
Rosemary H. Crowder

Robert C. Crowder
Rosemary H. Crowder

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental
Protection Agency
1200 6th Ave.
Seattle, Wa 98101

cc: Col. Wilbur Gregory
District Engineer
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, Ak 99506-0898

cc: Mr. Bob Grogan, Director
Division of Governmental Coordination
Pouch AM
Juneau, Alaska 99811

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FOSS Maritime

Foss Maritime Company

THOMAS V. VAN OAWARK
President and Chief Executive Officer

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May 21, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

Foss Maritime Company supports U.S. Borax's efforts in their Quartz Hill project and applauds the commitment in time and expense they have already given to gathering environmental background data.

Alaska has not flourished since the oil pipeline. The decline of oil prices has left the Alaskan economy in a depressed state. The assured cooperation of U. S. Borax with both the U. S. Forest Service and envlromental impact groups in the building and operation of the Quartz Hill plant, Borax' plan for preferential hiring of Ketchikan residents and Alaskans, and the resulting infrastructure and the molybdenum mine, will bring renewed strength to the Alaskan economy.

We urge you to consider the positive impact this project will have on Alaskans and on the Alaskan economy and grant approval to U.S. Borax.

Very truly yours,

T. Van Oawark

/dl

660 WEST EWING STREET • SEATTLE, WASHINGTON 98119 • PHONE (206) 281 3800 • TELEX 32 0132 FOSS SEA

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BILL ROTECKI
BOX 7738
KETCHIKAN AK, 99901

26 MAY, 1987

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MR WIN GREEN
FOREST SUPERVISOR
USFS
FED BUILDING
KETCHIKAN, ALASICA 99901

DEAR SIR:

I AM IN FAVOR OF IMPLEMENTATION OF THE U.S. BORAX MINE. I HOPE IT IS ALLOWED OPERATE IF AND ONLY IF IT DOES NOT ADVERSELY AFFECT OTHER ASPECTS OF OUR ENVIRONMENT AND ECONOMY HERE IN SOUTHEAST ALASKA.

WHAT IS THE ADVANTAGE OF HAVING A MINE WHICH CREATES JOBS FOR 100 YEARS IF IT RUINS SALMON RUNS FOR 1000 YEARS? IF WE DO NOT KNOW WHETHER OR NOT THE FISHERIES WILL BE HARMED PERMISSION TO DO THOSE ACTIVITIES IN DOUBT MUST NOT BE GRANTED UNTIL IT IS CLEAR THERE WILL BE NO NEGATIVE REPERCUSSIONS.

US. BORAX SHOULD NOT BE GIVEN ANY BENEFIT OF THE DOUBT. ALL ENVIRONMENTAL CONTROLS SHOULD BE ENFORCED AS THEY WERE INTENDED. WE THE PEOPLE OF KETCHIKAN AND SOUTHEAST AK (AND NORTHERN B.C. AS WELL!) WILL BE LEFT WITH

THE CONSEQUENCES IF THINGS DO NOT GO WELL. THERE IS TREMENDOUS POTENTIAL FOR RUINED FISHERIES, FUTURE TOURIST INDUSTRY AND A HUGE SCAR ON WHAT WOULD OTHERWISE BE A WILDERNESS AREA IN A NATIONAL MONUMENT, THE STOCKHOLDERS OF U.S. BORAX AT WORST, WOULD BE LEFT WITH A TAX WRITEOFF, REAL

PLEASE USE ALL CARE POSSIBLE TO ENSURE THAT THIS PROJECT PROCEEDS WITH ALL ENVIRONMENTAL SAFEGUARDS REMAINING IN FULL FORCE,

THANK YOU.

SINCERELY YOURS,
William F. Rotecki
WILLIAM F ROTECKI

I AM A FISHERMAN, CARPENTER, AND PROPERTY HOLDER IN KETCHIKAN AND STAND TO WIN OR LOSE AS MUCH AS ANYONE ELSE DEPENDING ON THE OUTCOME OF THIS MINE AND ITS OPERATION.

City of Ketchikan

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May 26, 1987

Mr. Win Green
Forest Supervisor
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

During its May 21, 1987 regular meeting, the Ketchikan City Council passed and approved Resolution No. 87-1510, a resolution supporting the development of the Quartz Hill Molybdenum deposit near Ketchikan. A copy is enclosed.

I wish to take this opportunity on behalf of the City Council and the community of Ketchikan to urge you and your agency to carefully consider the full range of issues before you as you evaluate your agency's position on this matter. Economic development is very important to the State of Alaska and to this region at this time in our history.

Ketchikan needs new jobs that provide stable, year-round employment. A fluctuating work force can have a particularly devastating impact upon a relatively isolated community such as Ketchikan, since workers have few alternatives for other employment within the community. Therefore, the economics of mine development are as essential to this community as they are to U.S. Borax. You have heard the corporation argue that economics will dictate start-up time. You have also heard that economics will play a major role in long-term operation of the mine by determining the competitiveness of the its product. A competitive product translates into stable employment and a healthy addition to the local economy.

We all want environmentally sound development; and we want and need economic development to help our struggling communities. The Wilson Arm option can help provide both.

Thank you for your consideration. If you have questions, please contact me.

Sincerely,

Ted Ferry, Mayor

Enclosure

c.c. W/Enclosure
Director, Water Division, Region X, U.S. Environmental Protection Agency
District Engineer, U.S. Army Corps of Engineers
Director, Division of Governmental Coordination, Office of the Governor

USB0000003/USB/MGRSEC

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THE CITY OF KETCHIKAN ALASKA

RESOLUTION NO. 87-1510

A RESOLUTION OF THE COUNCIL OF THE CITY OF KETCHIKAN, ALASKA, SUPPORTING THE U.S. BORAX DEVELOPMENT OF THE QUARTZ HILL MOLYBDENUM DEPOSIT NEAR KETCHIKAN, ALASKA, AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS the development of the State's mineral resources is important to the future of the State; and

WHEREAS, the Quartz Hill molybdenum deposit near Ketchikan, Alaska, contains over ten (10) percent of the world's supply of molybdenum; and

WHEREAS, the United States Borax Company (U.S. Borax) has invested over one hundred thousand dollars ($100,000,000) in the project since the ore deposit was discovered in 1974 without asking for financial support or guarantees from the State or the local community; and

WHEREAS, development of the Quartz Hill Mine would strengthen the economy of Southeast Alaska by providing thousands of construction, development, and production jobs for an estimated fifty-five (55) years; and

WHEREAS, the City Council of the City of Ketchikan desires to do all in its power to encourage and assist U.S. Borax to begin operating the Quartz Hill molybdenum mine project as soon as possible, because it would meet a clear and present need for development and diversification of the area's economy; and

WHEREAS, the City Council of the City of Ketchikan desires that the development of the Quartz Hill molybdenum mine be planned and conducted in a manner that minimizes the project's negative effects on the environment; and

WHEREAS, the City Council of the City of Ketchikan desires that the development of the Quartz Hill molybdenum mine be planned and conducted in a manner that maximizes the economic benefits and minimizes the socioeconomic disadvantages to this community, the region and the State; and

WHEREAS, the City Council of the City of Ketchikan understands that the issue of tailings disposal is key to the near-term start-up and to the long-term competitiveness of the mine; and

WHEREAS, the City Council of the City of Ketchikan understands that the U.S. Forest Service and the Federal Environmental Protection Agency (EPA) are presently considering whether to allow project tailings disposal in the Wilson Arm; and

WHEREAS, the City Council of the City of Ketchikan further understands that the U.S. Forest Service "preferred alternative for tailings disposal is marine disposal in the Wilson Arm", and

that the EPA concurs with the Forest Service preferred alternative with the exception that the "EPA has concluded that the middle basin of Boca de Quadra is the environmentally preferred location for mine tailings disposal"; and

WHEREAS, the Quartz Hill Molybdenum Project Mine Development Revised Draft Environmental Impact Statement states that "[t]he EPA and the Forest Service are particularly interested in receiving information which would help assess the significance of the visual and aesthetic effects of the tunnel portal on Boca de Quadra's shoreline and the socioeconomic impacts associated with a Boca de Quadra tailings disposal"; and

WHEREAS, the City Council of the City of Ketchikan understands that the RDEIS represents the summary of considerable scientific and other technical review and analysis of the various issues and options related to the tailings disposal question; and

WHEREAS, the City Council of the City of Ketchikan understands that the Boca de Quadra option for mine tailings disposal will cost approximately fifty-nine million dollars ($59,000,000) more to construct and significantly more to operate during the life of the mine than the Wilson Arm option; and

WHEREAS, the City Council of the City of Ketchikan understands that an increase of such magnitude to front-end project costs diminishes the likelihood that the mine will prove economically viable in the near future and could therefore unreasonably delay mine start-up, especially in light of the present-day market for molybdenum; and

WHEREAS, the City Council of the City of Ketchikan further understands that significantly increased long-term operating costs will likely reduce the competitiveness of the Quartz Hill mine product in the market and thereby aggravate normal cyclical fluctuations in the mine's work force; and

WHEREAS, a fluctuating work force can have a particularly devastating impact upon a relatively isolated community such as Ketchikan, since workers have few alternatives for other employment within the community; and

WHEREAS, in light of these factors, the City Council of the City of Ketchikan approved on June 19, 1986, Resolution No. 86-1474 urging the U.S. Forest Service and the Federal Environmental Protection Agency to select the Wilson Arm option for tailings disposal for the U.S. Borax Quartz Hill molybdenum mine project; and

WHEREAS, the City Council of the City of Ketchikan desires to support the U.S. Forest Service preferred option for mine tailings disposal.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF KETCHIKAN, ALASKA AS FOLLOWS:

Section 1. The City Council of the City of Ketchikan hereby reaffirms its June 19, 1986, approval of Resolution No. 86-1474 urging the U.S. Forest Service and the Federal Environmental Protection Agency to select the Wilson Arm option for disposal of the US Borax Quartz Hill molybdenum mine tailings, a copy of which resolution is attached hereto and made a part hereof.

Section 2. The City Council of the City of Ketchikan strongly urges the U.S. Forest Service and the Federal Environmental Protection Agency to give all possible consideration to project economics in weighing tailings disposal alternatives and other issues affecting the U.S. Borax Quartz Hill molybdenum mine project permitting process, and to endorse reasonable cost-effective measures or alternatives as a means to balance the need to mitigate the environmental impact of project construction and operation with the community's clear and strong need for stable, year-round employment.

Section 3. The Council of the City of Ketchikan concurs with and supports the U.S. Forest Service preferred option of using the Wilson Arm for the disposal of the Quartz Hill mine tailings in light of findings that

1. With appropriate mitigation, there is little difference in the environmental effects of tailings disposal in the marine environment between the Wilson Arm and Boca de Quadra fjords.

2. The effect, with appropriate mitigation, of marine tailings disposal on anadromous fish, other food fish, and fish habitat is similar in both fjords.

3. The Wilson Arm alternative offers the following added and significant advantages:

   a. The impacts of the mine development are confined to a single drainage. This avoids spreading the impacts to a second drainage basin of about eighteen (18) square miles, most of which is in the National Monument Wilderness. These impacts would include the need for people in the Wilderness to operate, maintain and monitor the tailings disposal system.

   b. It reduces the impacts on wilderness values since it is not necessary to construct facilities for tailings disposal in the Misty Fjords National Monument Wilderness as would be required if disposal were in the Boca de Quadra. These would occupy about twenty-five (25) acres, stretching from tidewater to an elevation of about one hundred (100) feet, and

Resolution No. 87-1510
Page 4

would include a wharf, road, large diameter pipeline, buildings, storage areas, tanks and mobile equipment.

c. Based on historic molybdenum markets, disposal in the Wilson Arm would result in greater community stability for Ketchikan and Southeast Alaska because of reduced operating costs and lesser development costs compared to disposal in Boca de Quadra. Specifically, the capital cost difference between tailings disposal in Wilson Arm and in Boca de Quadra is approximately fifty-nine million dollars ($59,000,000), plus increased costs for pumping and other operations of one million six hundred thousand dollars ($1,600,000) per year. These costs taken together are equivalent to increasing production costs by about fifty-five cents ($0.55) per pound of molybdenum, the equivalent of increasing the annual payroll cost by fifty (50) percent.

Section 4. The City Council of the City of Ketchikan hereby directs the Mayor to send copies of this resolution to Win Green, Forest Supervisor; Governor Steve Cowper; Commissioner Smith, Department of Commerce and Economic Development; Commissioner Hoffman, Department of Community and Regional Affairs; Commissioner Kelso, Department of Environmental Conservation; Commissioner Collinsworth, Department of Fish and Game; Commissioner Brady, Department of Natural Resources; Director, Water Division, Region X, U.S. Environmental Protection Agency; District Engineer, U.S. Army, Corps of Engineers; Director, Division of Governmental Coordination.

Section 5. This resolution shall be effective immediately upon passage.

PASSED AND APPROVED THIS 21st day of May, 1987.

Alarie Stanton
Alarie Stanton, Vice Mayor

ATTEST:

Karen Miles
Karen Miles, CMC
City Clerk

RES0000004/MEMOSCOUNC/MGRSEC

University of Idaho
College of Mines
and Earth Resources
Department of Metallurgical
and Mining Engineering
Moscow, Idaho 83843
(208) 885-6376

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May 26, 1987

Mr. Winn Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I am writing to you about the Quartz Hill Project of the U.S. Borax Company.

I've been waiting with much anticipation to see the project get underway. I have followed the special efforts made by the company to preserve the area in its best natural beauty, while still taking advantage of the uniqueness of the deposit to help the economy of Alaska and our country.

We cannot rely upon a service and information economy solely to compete with the rest of the world. This has been proposed by many people, but with little substance other than belief to back it. We are now seeing the high technology as an additional take over by the rest of the world and even to the extent of telephone conversations over the 800 numbers going offshore.

I believe the company has done a superb job of making plans for protection of the environment such that the degradation will be no greater than nature itself would impose but obviously over a much longer period.

Alaska is particularly subject to income from taxes or natural resources. Without both in balance, the progress you have made will not continue or even be secure. The income, jobs, social stability and the economy of the area will be greatly enhanced by this project for a very long time. I believe it would be short sighted and contrary to the best interests of Alaska, if the project were not to proceed.

Obviously no activity in any area can guarantee absolute environmental purity. Not even nature does this. We have trade-offs we must make between our economy, social well being and the environment. If we are hungry or without work, no matter what our surroundings may be, our immediate and effective environment is unacceptable. If we are not

Where Tradition Meets the Future
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willing to utilize the materials nature has provided for us, by setting up proper safeguards and environmental controls and living by them, we then must reconcile that our civilization is to return to a hunting and fishing way of life. This may sound good, but it would not provide us with all of the facilities and progress we have today.

The product Quartz Hill will produce - molybdenum - is used by you regularly in the mechanical equipment, planes, boats and trucks and it is to your benefit to be a part of this in producing the metal. More importantly the tremendous number of dollars that will go into making the mine operate, as well as the annual income, both taxable and trickle down, through purchases and wages will enable the area to prosper. Even your paycheck is partly dependent upon this type of income. Without it we will have little chance of even protecting the forests or any of our environment if we don't have adequate income and industrial structure in our country.

I am anxious that you see the absolute necessity of a viable Quartz Hill project and I would urge you to expedite its preparation and operation in any way that you can.

Sincerely,

J. R. Hoskins

J. R. Hoskins
Head, Department of Metallurgical
and Mining Engineering

JH/ec

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J. B. DAVIS

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May 26, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill

Dear Mr. Green:

As you know, U.S. Borax is in one of their final decision phases for the Quartz Hill Project. It is very important that they receive the necessary support and professional evaluations required in their permitting process in order to develop a project which is badly needed in southeast Alaska. Please consider this letter as my strong endorsement of the project and it is hoped that you also will be able to see your way clear to allowing U.S. Borax to proceed with the project with a reasonable and prudent set of rules and regulations in the permitting area.

While not intimately familiar with the details of the proposed submarine tailings disposal, it is my feeling that the massive studies that have been made are more than sufficient to make a decision on whether the Wilson Arm/Smeaton Bay site can be used. I personally would hope that you see the way clear to allow U.S. Borax to use this site based on the data available.

U.S. Borax has publicly stated that they are attempting to design a mining program which is environmentally acceptable and meets all of the requirements that we all feel are necessary in order to have successful projects. This is the only way to go and it must be a mutual effort which developes the natural resources of our nation while protecting the environment so that we have our other resources for years to come. It is my feeling that U.S. Borax is attempting to do this and with your help, I'm sure that they will have a very successful and acceptable project for all concerned.

Again please consider this my firm support of the project and it is hoped that you will see your way clear to grant U.S. Borax the permits that they need in order to proceed.

Sincerely,

J. B. DAVIS
JBD/eak

cc: U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
State of Alaska

P.O. BOX 17240 / TUCSON, AZ 85731

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Chevron U.S.A. Inc.
3001 C Street, Anchorage, AK 99503 • Phone (907) 563 2556

T. P. Gallagher
Public Affairs Manager

May 27, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a twenty year resident of Alaska, I have heard many administrations call for diversification of our economy. As you might agree, long term diversification is the key element to a stable economy.

I believe the Quartz Hill Project can make great strides in that long term diversification and stabilization of our economy. The Project will provide jobs, both short term and long term, state revenues, and expansion of the Ketchikan and Alaska economy.

I believe that a balanced approach to the Project will help our state and our economy. Please join me in supporting the Quartz Hill Project.

Diversification should not be a buzz word for all state administrations. It should be a goal that we work toward and make a reality.

Sincerely,

Tom Gallagher

T. P. Gallagher

TPG:mw

cc: Mr. Robert S. Burd, Director, Water Division
Region X, U.S. Environmental Protection Agency
1200 Sixth Avenue, Seattle, WA 98101
Colonel Wilbur Gregory, District Engineer
U.S. Army, Corps of Engineers
P.O. Box 898, Anchorage, AK 99506-0898
Mr. Bob Grogan, Director, Office of the Governor
Division of Government Coordination
Pouch AM, Juneau, AK 99811

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QUARTZ HILL PROJECT

USBORAX

May 4, 1987

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Chevron U.S.A., Inc.
P.O. Box 1580
Anchorage, Alaska 99510

Attached is our brochure "AN INVESTMENT IN ALASKA'S FUTURE" which focuses on the future significance of Pacific Coast Molybdenum Company's Quartz Hill Molybdenum Project and the broad socioeconomic benefits that will accrue from it.

Our goal is to design, construct and operate Quartz Hill based on good engineering and environmental practices and in accordance with economic principles that will assure a competitive project. We are convinced this will require reasonable environmental controls including Wilson Arm/ Smeaton Bay submarine tailings disposal.

We are now in the critical "DECISION PHASE" and need your support!

If you believe, as we do, that the Quartz Hill Project will benefit the people of Alaska and should proceed in an environmentally reasonable and economically secure manner, PLEASE take the time to write a letter to the Federal and State agencies listed on page three of the attached brochure.

Sincerely,

D.L. Finney
Ketchikan Manager
Quartz Hill Project

Attachment

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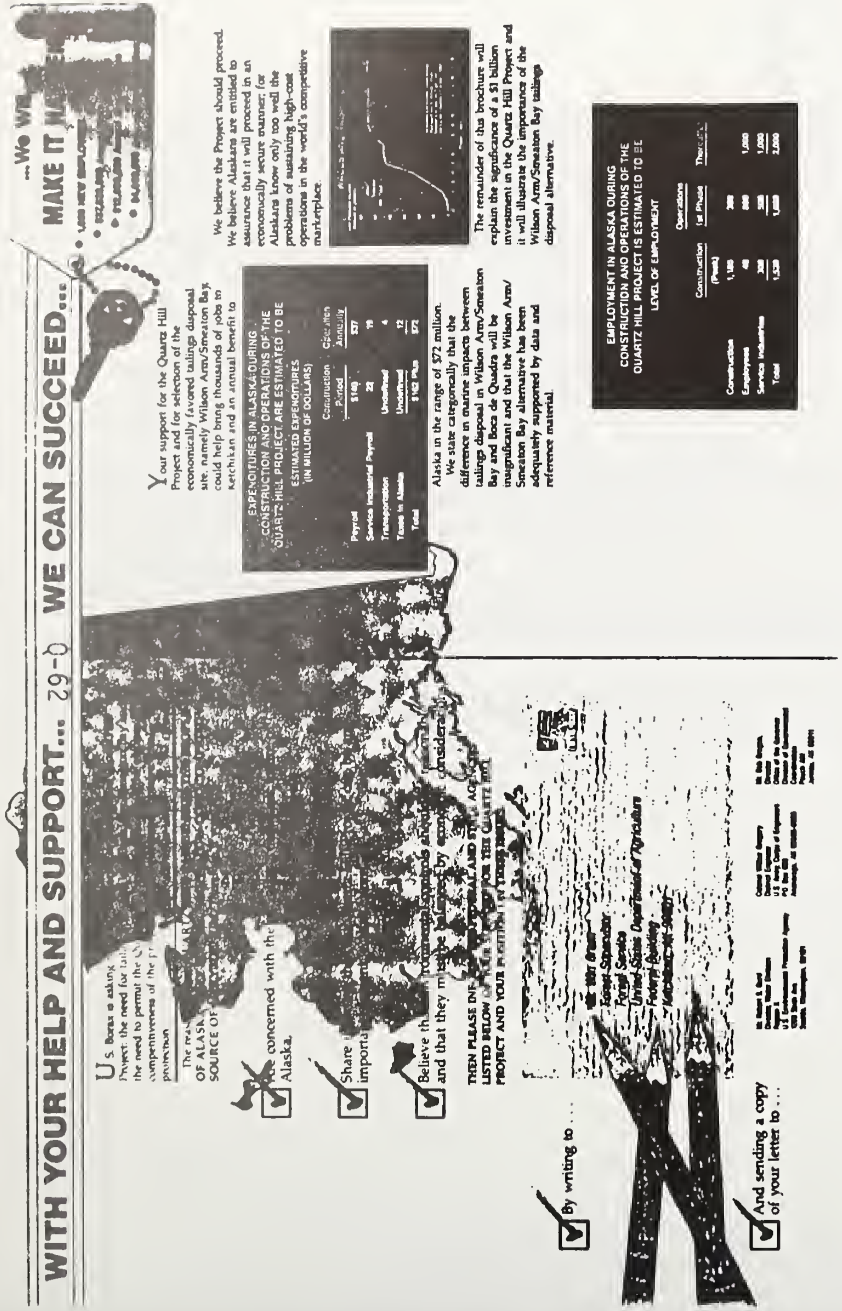

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National Bank of Alaska
Ketchikan Branch 108 Main Street • Ketchikan Alaska 99901 9990 • (907) 225-2184

May 29, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Green:

As a lifelong Alaskan I am writing this letter in support of the efforts being made by U.S. Borax to develop the Quartz Hill mining project.

Over the past twenty years we have all seen how it is possible to develop our State's mineral resources without causing significant harm to our environment. The long term economic benefits gained from using Wilson Arm, rather than Boca de Quadra for tailings disposal far outweigh whatever environmental benefit (if any) would be gained by using the latter site. The fact that the Forest Service, with all of its quite proper environmental concerns found that there was little difference between the two sites, indicates that the decision can be made on the basis of economic benefits. The Wilson Arm alternative is clearly superior in that regard.

Again, I fully support the U.S. Borax project, and recommend that your agency do everything possible to expedite the entire process.

Sincerely,

Don Thornlow

Don Thornlow
Sr. Vice President

DT/ddc

cc. Robert S. Burd
Colonel Wilbur Gregory
Bob Grogan

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E. O BRACKEN, P.E.
GEOLOGIST & MINING ENGINEER

P O Box 1098
JUNEAU, ALASKA 99802

TELEPHONE
(907) 789 7341

May 27, 1987

Mr. Win Green, Forest Supervisor
U.S. Forest Service
Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Supervisor:

The Quartz Hill Molybdenum Project has already absorbed a great amount of investment in research and environmental study, and the economic activity generated in the process has already had a beneficial impact on the regional economy. Both the Forest Service and the mining company deserve credit for the patience demonstrated and the thoroughness of the environmental research accomplished. (It would be interesting to compare the weight of paper generated in opposition to and support of the project with the size of the bulk sample, which is the only commercial production to date.)

As a result of these studies, the mining operation should be as nearly environmentally sound and practical as possible. Meanwhile, the major commercial advantage to the region and the balance-of-trade advantage to the nation will depend upon economic recovery of the investment for developing and mining the deposit.

The alternative for tailings disposal in Wilson Arm offers a clear advantage in the size of required investment, and the disposal is designed to be below the depth of influence to fisheries and marine habitat.

The preferred alternative seems to be the practical and environmentally sound solution in view of lowering metal prices and increasing operating costs.

Sincerely,

E.O. Bracken
E.O. Bracken

Cc: Region X
U.S. Environmental Protection Agency

District Engineer
U.S. Army, Corps of Engineers

Alaska Division of
Governmental Coordination

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Stephen M. Connelly
P.O. Box 100
Thorne Bay, AK 99919

May 27, 1987

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Mr. Win Green, Forest Supervisor
U.S.D.A. Forest Service
Ketchikan, AK 99901

Dear Mr. Green:

I am writing as an Alaskan resident and citizen of the United States to express my views concerning the Quartz Hill Molybdenum project.

From reviewing presented documents, it is evident that tailings can be disposed of in Wilson Arm/Smeaton Bay without undue harm to the environment. I strongly support this alternative. A camp should also be allowed at the mine site as there will be little environmental impact in the long run and the City of Ketchikan will still greatly benefit in providing support services.

I also believe the socioeconomic effects of all alternatives must be considered. This project and other natural resource developments in Alaska do not take place in a vacuum, but rather have a direct impact upon the residents striving to make a year-round living directly or indirectly from Alaska's natural resources. There are important costs and benefits which need to be weighed. The employment created by this project and the added diversification of the economy are vital to our State and its people. These benefits spread over the life of the mine will be immense and the environmental impact minute.

I urge you to please use your professional judgement and training to examine the long run costs and benefits of this project. As a forester myself, I am only too aware of how short run oriented the pro and anti-development public can be in such matters. As we look 50, 75, 100, or more years down the road,

however, I think you will agree that any possible adverse impacts of this project become quite negligible.

Sincerely,

Stephen M Connolly

cc: Mr. Robert S. Burd, U.S. EPA
Col. Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Division of Governmental Coordination

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May 29, 1987

Mr. Win Green - Forest Supervisor
Forest Service - USDA
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill project

Dear Mr. Green:

After reviewing portions of the Revised Draft EIS for the above referenced project, I would like to write in support of the alternative to place tailings in Wilson Arm, as opposed to Boca De Quadra.

The Wilson Arm alternative appears to be very safe from an environmental viewpoint. It is also very important to the developers from an economic standpoint. This project will have to be economically competitive to bring benefits to Alaska. It is fortunate to have a situation where the Wilson Arm alternative is not only safe environmentally, but will provide good economic potential.

I appreciate all the work that your agency and other agencies have gone to in order to make sure this project will be safe as well as beneficial. It would really be nice to see the fruits of the labor for all participants to come into bloom on this project. Too often Government is seen as an obstacle to projects. The Quartz Hill project can be one where there is a good partnership between government and the developers.

Thank you for your attention to my thoughts on this matter. I look forward to seeing the decision on this matter come forth this summer. I am hopeful that the Wilson Arm alternative will prevail.

Sincerely,

Jeffry J. Cook

cc: Mr. Robert S. Burd, Director
Water Division - Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

discover Alaska

83

LIVENGOOD/TOLOVANA MINING DISTRICT

P. O. BOX 73069 - FAIRBANKS, ALASKA 99705

May 27, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Ak 99901

Dear Mr. Green;

The Livengood/Tolovana Mining District is vitally interested in the development of Alaska's natural resources. We believe that only through responsible development of our resources will the economic stability that is so vital to Alaska become a reality.

We understand that the U.S. Borax Quartz Hill molybdenum project is moving into the final stages of development. We support the Quartz Hill Project. We also support the Wilson Arm/Smeaton Bay as a tailings disposal site, as we understand there will be insignificant differences in the marine impact between Wilson Arm/Smeaton Bay and Boca de Quadra.

We appreciate your assistance in ensuring that this project continues. We know that the people of Alaska need a stable economic climate. We believe that through developments, such as the Quartz Hill project, that stability will be achieved.

Sincerely yours,

Rose Rybachek

Rose Rybachek, President

CC: Robert S. Burd
Wilbur Gregory
Bob Grogan

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Hrg
HAWLEY
RESOURCE
GROUP, INC

May 28, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

This is to urge your continued support for the U.S. Borax Quartz Hill project. Because of the improved economic viability and insignificant environmental differences of the project with tailings site at Wilson Arm vs. Boca de Quadra, the Wilson Arm site is greatly preferred.

Sincerely,

Chuck Hawley

C. C. Hawley

cc: Mr. Robert S. Burd, U.S. EPA
Colonel Wilbur Gregory, U.S. Corps of Engineers
Mr. Bob Grogan, State of Alaska

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Mr. Win Green
Forest Supervisor
Forest Service
U. S. Dept. of Agriculture
Federsl Building
Ketchikan, Alasks 99901

Re: Quartz Hill

Dear Mr. Green:

I have lived in Ketchikan for seventeen years so my comments are those not of s long-timer but certainly not of a new resident.

When my wife and I first moved to Ketchikan there were three houses for sale of which we bought one. Today there are several hundred on the market. The prices of real estate have, of course, reacted to market conditions so that what cost $25,000 a few years ago sold for $75,000 ten years later but is only worth $65,000 today. This kind of price gyration plays havoc with the personal finances of the average wage earner. A more stable market could be possible with a more stable local economy.

While this small personal example is meant to illustrate a point, there are several other arguments that also are valid for a more stable local economy.

While our power rates are pretty well established for a long period of time, there is a suplus of power that if marketed could either lower or firm up present prices. With the State of Alaska's revenue in decline because of oil prices, that lowering of income will mean less money passed through to local government. That in turn means locsl residents must bear a higher portion of expenses such as education and other government services. The more stable the local economy, the more palatable that prospect becomes.

The one major employer who wsnts to be a part of Ketchikan's economy is U. S. Borsx. I firmly support their desire to operate a mine at Quartz Hill if for no other reason than my selfish desire to stabalize the local economy.

That the mine tsilings must be disposed of is a fact of life. I support their request to dump into the Wilson Arm. I further support their application for s fresh water supply dam. This will assure them of a low-cost long range dependable source of water. The last factor needed to make the mine economically viable is the cost of power. As I mentioned before while there is a surplus of local power, that surplus is not large enough for U. S. Borax. What is needed then is a power into-tie in S. E. Alaska to make it possible to use B. C. power, Swan Lske or Tyee power as needed at the mine. I am not suggesting thst these things be done st no cost to U. S. Borax nor are they asking for that. What is needed is the necessary permits to make it possible to negotiate to have a power inter-tie. That is where you can make a difference and I urge you to spprove the plans submitted by U. S. Borax.

As I stated in my opening paragraph, I've lived in Ketchikan for seventeen years. I'd like to think that my children could also live here if thst is their choice. The economy will hsve to grow but not in a boom/burst cycle to make that all possible. I see U. S. Borax as one potential contributing factor to the growth pattern that I see as being desirable for my family in particular and Ketchiksn in general.

In closing, I urge you to grant the necessary permits to U. S. Borax so thst their mine csn become s reality operating at a low cost on a steady basis for years to come.

Sincerely,

R. M. Watt

R. M. Watt

cc. EPA
U. S. Army Corps of Engineers
Office of the Govenor

86

P.O. Box 566
Ward Cove, AK
99928

May 28, 1987

Mr. Win Green
Forest Supervisor
United States Forest Service
U.S.D.A.
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am writing to you in support of the U.S. Borax proposal for development of the Quartz Hill Molybdenum project. It is, in my opinion, very important to encourage significant investment by private industry in Southern Southeast Alaska. There are several reasons for this, not the least significant being a resultant decrease in pressure on the embattled Tongass National Forest for economic support of the area.

Ketchikan is in need of the same type of future economic development that is taking shape in the form of the Green's Creek project on Admiralty Island in Northern Southeast. In this regard I stand in support of the Wilson Arm/ Smeaton Bay tailings disposal area; I also support the objective 'weighing' of any future environmental control against the economic cost of said controls -- with the intense spotlight that has been focused on the Quartz Hill Project and U.S. Borax's stated intention to defend the environment, I feel that environmental controls and economic development can coexist -- and should.

Best Regards,

Randall C. Shaver

CC. Mr. Robert S Burd (E.P.A.)
Col. Wilbur Gregory (Corps of Engineers)
Mr. Bob Grogan

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Route 1, Box 155
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May 27, 1987

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Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I am writing to comment on the Forest Service's Revised Draft Environmental Impact Statement "Quartz Hill Molybdenum Project Mine Development".

In my view, the very great difference in capital and operating costs between disposing of tailings in Wilson Arm and Boca de Quadra, combined with the marginal differences in likely environmental impact, make the Forest Service's preference for Wilson Arm disposal the only logical and common sense position.

I would also like to strongly support the need for permitting the Quartz Hill project. While the present economic climate for molybdenum argues against any immediate investment in molybdenum production at Quartz Hill, the size and quality of the ore body and the steady growth in the demand for molybdenum make it highly desirable that such a strategic resource should be made available to the United States and world markets when the time is right.

Thank you for your attention.

Sincerely,

I. L. White-Thomson

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, Washington, 98101

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Colonel Wilbur Gregory
District Engineer
U. S.Army, Corps of Engineers
P. O. Box 898
Anchorage, AK 99506-0898

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May 29, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

We have followed for several years the proposed mining project at Quartz Hill by U. S. Borax Company.

We have just seen a presentation by the Company on their latest draft environmental report and continue to be impressed with the concern this Company has for our State and our natural resources. Despite the poor economic conditions in Alaska today we cannot use present circumstances to overlook the long range impact the project will have on the environment.

In my opinion U.S.Borax deserves an "A" for their diligence in taking the necessary precautions to be sure their project was environmentally safe.

Alaska needs this project, and U.S. Borax needs Alaska. We must allow the project to be competitive in the world market or it either won't be built or it will be shut down if their operating costs are out of line with competitors. Unreasonable environmental controls can increase operating as well as capital costs.

Sincerely yours,

THE NERLAND CORPORATION

A. Ronald Nerland
Chairman and CEO

cc: U.S.Environmental Protection Agency, Seattle, Washington

U.S.Army, Corps of Engineers, Anchorage, Alaska

Office of the Governor, State of Alaska, Juneau, Alaska

89

Alaska Cruise Lectures

Box 8595
Ketchikan, Alaska 99901

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June 1, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Green:

The ALASKA CRUISE LECTURERS would like to go on record as supporting the U.S. Borax project near Ketchikan.

There are 18 representatives in our organization, all of whom are long-time Ketchikan residents. We all have families who appreciate the outdoor beauty here yet who understand the need for a diversified economy for our community so that we can afford to live here year-around.

Our main function as guest lecturers aboard cruise ships is to present Alaska, generally and specifically, through slide lecture programs and commentary from the ship's bridge in various scenic areas. Misty Fjords National Monument is one such area which we are particularly proud to "present."

We feel that Misty Fjords is a good example of how Alaska's size and vast wilderness makes it possible to preserve and appreciate wildereness in partnership with responsible development from companies such as U. S. Borax.

U. S. Borax has demonstrated its environmental concern. We believe there can be productive harmony between U. S. Borax and the environment.

We endorse the intentions of U. S. Borax, and we hope that it will be economically viable for the mine production to proceed -- for the benefit of our community and our nation.

Sincerely,

ALASKA CRUISE LECTURES

Nancy M. Watt

Nancy M. Watt
Representative

c: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

90

RICHARD WHITTAKER
Box 3313
Ketchikan, Alaska 99901

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1 June 87

Mr. Win Green, Forest Supervisor
USFS, Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: U.S. Borax tailings dump

Dear Mr. Green:

Q-69

The Ketchikan Chamber of Commerce President has thoughtfully redirected my attention to the Quartz Hill tailings problem. I have a somewhat different view of the matter. First of all, I disagree with the Alaska Commissioner of Commerce in his view that the future of our state lies with mining. This is not born out by the facts, particularly with regard to the economic needs of the Ketchikan area. We need more jobs, but will find them by making forestry and fishing more labor intensive.

#1

I have sat back and watched the battle between the Borax forces and the conservationists and believe they are both wrong. What is a fact is that we do not know what the future of the mine is. If it opens, how long will it operate? It seems to me that making provision for the start up and operation of the mine for a number of years is all that is in question at this time, ergo, what the mine needs is dry land storage of tailings for a period of time after which it can be determined whether it is necessary to fill the fjord. To look at a plan which assumes that the mineral will all be mined, considering the history of mining, is foolishness.

I would urge you to adopt a policy designed to meet a reasonable need for a foreseeable future.

Sincerely,

Richard Whittaker

cc: Robert S. Burd
Col. Wilbur Gregory
Bob Grogan

91

CURTIS G. SHATTUCK
301 SEWARD STREET
JUNEAU, ALASKA 99801

June 1, 1987

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Win Green, Forest Supervisor
U. S. Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill

Dear Sir:

To add some legitamacy to what follows, let me say that I was born in Juneau 80 years ago; that my Mother came to Alaska in 1886 with her father, Gov. A. P. Swineford. My home remains in Alaska, and my feeling for this State is great and deep.

The U. S. Borax Co. has taken extraordinary steps and spent a large amount of money to protect the environment as much as is reasonably possible. Obviously, no project large or small can fail to have some impact on the environment.

The cost-benefit ratio must necessarily be a consideration if we are to see any new industrial development. In this instance, the tremendous economic benefit to all of Alaska as the result of the opening of the Quartz Hill mine is obvious. To deny this development because of contentions that it may (not "will") adversely effect the environment in some manner just does not make sense.

Environmental groups simply oppose development, period. To the best of my knowledge, there has never, repeat never been a single instance in Southeast Alaska where any environmental group supported any one industrial development.

Several years ago an astute observer pointed out, in the Los Angeles Times, that the Sierra Club in the early 1960s objected to coal-generated electricity because of the air pollution problem, and said that nuclear power was the best alternative. By the late 1970s, they decided that nuclear power was not the answer and that coal was. As the writer pointed out, Sierra Club didn't want answers, they simply wished to obstruct.

When the hot oil pipeline from Prudhoe Bay to salt water was under consideration, environmentalists screamed that it would decimate the caribou. Now it seems that the caribou herd in the Prudhoe Bay area has increased several fold in the last 15 or 16 years.

91

Win Green - 2

During this same period when the line was being built, an environmental writer named Jim Bashline, in an outdoor column in a Pennsylvania newspaper wrote that, among other things, "the natural expansion and contraction of 48-inch diameter pipe in temperatures that range from 60 below to 85 degrees above will move that pipe up and down like a Yo-Yo".

So much for environmentalist expertise.

Plainly we must not permit the sheer volume of strident vocal opposition by a small group of environmental activists to outshout and smother the facts with their unproven theories and their propaganda.

Quartz Hill is feasible and can be put into operation in the manner U. S. Borax proposes without unreasonable environmental impact; and the Sierra Club, SEACC and others should not be permitted to deny employment to hundreds of individuals nor to eliminate an important source of new tax revenue for the State of Alaska.

Sincerely,

Curtis G. Shattuck

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MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY

BUTTE, MONTANA 59701
406/496-4101

MINING ENGINEERING DEPT.

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Mr. Win Green, Forest Supervisor
Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Sir:

I take this opportunity to write in support of U.S. Borax's Quartz Hill Project. I am reasonably familiar with their efforts as two of my graduates were engineers on the project, and I have spoken with them at some length. Your concerns are, of course, echoed in Montana with our large National Forests and agricultural legislature. Like Alaska, we are underpopulated, and a natural resource dependent exporter. Montana has come to realize that major industry development is essential for the future of the state and its citizens.

After considerable over-reaction and punitive economic-environmental control, Montana now is opening its resource development with a more realistic effort. Our Eastern coal mines have demonstrated good or better reclamation is not only possible but typical. The miners and the Forest Service are working in harmony. This is pretty amazing considering the surge of new gold prospects and the attendant burden of the forests.

I do believe that industry must be cognizant of the environment and certainly responsible for their operations. I can only trust that you are aware of the economic impact on a mining project of the overzealous protection of the same environment. I believe that U.S. Borax has demonstrated remarkable care and concern in their efforts at Quartz Hill. Please lend them your best support.

Sincerely,

Tom Finch

Tom Finch, Ph.D., P.E.
Head, Dept. of Mining Engineering

TF/ta
cc: R. Burd
W. Gregory
B. Grogan

93

ROBERTSON, MONAGLE & EASTAUGH
A PROFESSIONAL CORPORATION
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POST OFFICE BOX 1211
JUNEAU, ALASKA 99802-1211

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550 WEST SEVENTH AVENUE, SUITE 1200
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ANCHORAGE, ALASKA 99510-0679
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OF COUNSEL
F. O. EASTAUGH

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M. E. MONAGLE (1902-1985)
JAMES F. CLARK
PAUL M. HOFFMAN
D. ELIZABETH CUADRA **
JAMES M. SHINE
PAMELA FINLEY
THOMAS J. SLAGLE

ADMITTED IN WASHINGTON, D.C. *
ADMITTED IN WASHINGTON, D.C. ** AND ALASKA
ALL OTHERS ADMITTED IN ALASKA

May 29, 1987

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Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill Mine Development
Revised Draft Environmental Impact Statement

Dear Mr. Green:

This letter responds to the invitation to comment stated in the last paragraph of the Summary to the above RDEIS.

My comment is based on my own beliefs derived from more than fifty years of experience with Alaska matters during my work and service with Alaska Steamship, Pan American Airways, and over forty years in this law office, dealing with transportation, tourism, timber, fishing, mining, municipal concerns and affairs. During this time, I served in the Legislature and on federal and state commissions and committees dealing with ANILCA and land use planning, and prepared the applications leading to the patenting of the Quartz Hill claims to Pacific Coast Molybdenum Company thereby becoming acquainted with the development plans for the ore body and the provisions of ANILCA dealing with the project. The thorough way the Company has met its obligations established my belief it would be a good citizen and a desirable part of Alaska's future.

#1

The issue of marine tailings in Boca de Quadra involves more than the visual and aesthetic effects of the tunnel portal being situated in the wilderness area of the Monument. Such disposal would necessarily require the leasing of at least 25

93

#1 Cont.

acres of land in the wilderness and result in the effects of construction there, the disposal of tunnel rock, and the operation and monitoring of the discharge operation. Such activity would require the transportation of material and personnel to the portal area during the fifty five year mine life. These detrimental impacts should be avoided if a reasonable alternative is available.

The RDEIS, by adopting the findings of the bulk sample analyses, shows conclusively that Wilson Arm-Smeaton Bay has more than adequate capacity to accommodate all of the mine tailings without detrimental effects to anadromous and other fishery species, thereby removing the lingering doubt of a previous suggestion to the contrary based on inadequate information.

Thus the Wilson Arm-Smeaton Bay alternative would avoid most, if not all, of the detrimental impacts necessarily associated with Boda de Quadra disposal. Furthermore, this alternative should be preferred because it would result in so many socio-economic benefits flowing from the reduction in capital and operating costs by eliminating (1) the capital cost of construction of the tunnel and portal, (2) the cost of energy to operate the tunnel, (3) the cost of transporting, operating, and monitoring personnel and (4) the supervisory and overhead costs thereof. These savings will result in substantial benefits by making the project more cost competitive in world markets, and thus a low cost producer that will be able to continue production during market downturns, be a dependable source of employment, a source of higher tax revenues, assure a market for goods and services for Ketchikan and other suppliers, and reduce the balance of payments by export of part of the product.

Another important and specific benefit of Wilson Arm-Smeaton Bay disposal, discerned from remarks by biologists at the Marine Tailings Symposium held at Ketchikan, is that at the end of the mine life the then shallower basin would provide a superior environment for an improved shellfish fishery that could not be developed in the deeper Boca de Quadra fjord.

#2

The development of the Snettisham hydro project, and the previous proposed Yukon-Taiyo hydro project made me aware of the substantial benefits to Southeast Alaska of an Intertie. The Quartz Hill project could augment such benefits by introducing low cost B.C. hydro power. While this possibility does not directly bear on the tailings disposal issue, it is one example of the many benefits that could eventually result when this project becomes operational.

I conclude that the Wilson Arm-Smeaton Bay alternative, upon the balancing of all environmental effects including the

93

Mr. Win Green, Forest Supervisor
Page -3-

socio-economic effects, is the preferred alternative. I also believe the RDEIS sets forth all of the facts supporting that conclusion and that the Forest Service and all who participated in its preparation should be commended.

Sincerely yours,

F. O. Eastaugh

POE:sd/1.21
cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

94

Lakloey, Inc.
General Contractor

1216 Rangeview Road
North Pole, AK 99705

Phone 907-488-9745

May 30, 1987

U.S. Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Attn Mr. Win Green
Forest Supervisor

Re: Public Comment on the Quartz Hill Mine

Dear Mr. Green:

It is imperative that the Quartz Hill Mine be allowed to go into production as soon as possible. Unreasonable economic restraints such as depositing tailings in the middle basin on Boca de Quadra, must not be impossed upon the mine operators. The economic health of Alaska and of the United States itself is at stake.

You will soon be deciding whether or not two generations of Alaskan's will benefit from this resource development project. I urge you to decide for Alaskans and for all Americans by permitting the Quartz Hill mine to go into production without the burden of undue economic restraints.

Sincerely,

Allen Vezey

cc: U.S. EPA
U.S. Army Corps of Engineers
Office of the Governor

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Mr Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr Green:

The State of Alaska's endeavors and efforts towards the development and realization of the Quartz Hill project as a competitive source of molybdenum is a project that I fully support.

This is a project that not only has been planned with the concerted efforts of many people, but by people who are knowledgeable, sensitive, and care about the future Alaska; and committed to the uncompromising preservation of the state's environment while working towards a healthy economic future.

Among the many issues involved in the planning and operation of the project is a decision for the selection of a site for tailings disposal; economics enters into this decision and I support and favor the Wilson Arm alternative to be the preferred, economic and environmentalwise.

Where but in this country can one contribute our thoughts, hopes and opinion towards the development of such a vital project which will affect so many importantly. Thank you for this opportunity.

Yours truly,
Irene Green

96

Juneau Branch
Alaska Miners Association

Box 1684
Juneau, Alaska 99802
June 1, 1987

USDA FOREST SERVICE
KETCHIKAN AREA
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Mr. Win Green
Forest Supervisor U.S.F.S.
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

We have followed the Quartz Hill molybdenum project over the past ten years. The RDEIS on the project currently under review must be considered in light of a few basic factors.

The development of the state's mineral resources is vitally important to the future of Alaska. It is critical that mining developments be planned and carried out in a manner that minimizes the effects on the environment. It is equally critical that the developments be carried out in a manner that maximizes the economic benefits and minimizes the socioeconomic disadvantages.

The U.S. Borax & Chemical Corp. has invested over $100,000,000 in the project since the ore deposit was discovered in 1974 without asking government financial support. Development of the mine would help stabilize the economy of Southeast Alaska by providing thousands of construction, development, and production jobs for more than 55 years while creating an additional tax base for the entire State.

This chapter of the Alaska Miners Association encourages the development of environmentally responsible mineral resource projects to ensure sound and secure sources of employment and sources of metals required in our society. Further we support cost-effective and environmentally responsible development and operation of the Quartz Hill molybdenum project.

It is essential that cost factors be taken into consideration in the final EIS. The U.S. Forest Service preferred alternative of tailings disposal in Wilson Arm takes into account the extraordinary costs in the tailings disposal alternatives. We urge you to maintain this position into the final EIS as it is the only reasonable alternative. The project will be able to start up earlier and remain financially healthier (fewer shutdowns) with the selection of Wilson Arm as the preferred disposal site.

Sincerely,

John Mulligan, Chairman Juneau Branch

97

EARL H. BEISTLINE
Mine Consultant

P.O. Box 80148
Fairbanks, Alaska 99708

(907) 479-6240

June 1, 1987

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JUN 4 '87
FOREST SUPERVISORS OFFICE

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a followup of my letter to you on May 1, 1987 pertaining to the U.S. Borax Quartz Hill Molybdenum project, the following additional information is offered based on my personal observation, mine employment and living in Juneau, Alaska for many years.

From about 1882 to 1917, mill tailings from the Treadwell Mines on Douglas Island were discharged into Gastineau Channel as evidenced by such deposits being visible at the present time. In about the early 1920's, mill tailings from the Alaska Gastineau Mine located near Thane, Alaska on the mainland about four miles southerly from Juneau were discharged into Gastineau Channel and such tailings are also visible at the present time.

Beginning in the teens of the century, the Alaska Juneau Gold Mining Company operating on the mainland near Juneau, Alaska produced about 12,000 tons of ore per day and discharged mill tailings into Gastineau Channel along the easterly side of the channel and immediately southerly from the city. Such tailings are visible at the present time. In addition, coarse sorted waste rock from the mill was discharged in Gastineau Channel to form the Rock Dump now supporting a number of man-made structures. In addition, a considerable amount of downtown Juneau is built on coarse waste rock fill from the mine, (includes facilities such as: hotels, State Museum, State office buildings, etc.). Also, in the downtown area the piling supported wood-plank Willoughby Avenue street along the mud flats and bordering the former location of the native villages was replaced with mine waste rock. For several years prior to the closure of the Alaska Juneau Mine in 1943, waste rock was no longer discharged on the Rock Dump but was hauled southerly of Thane, Alaska by barges having a capacity of 1000 tons each. The rock was discharged in grid areas by flooding compartments of the barge causing it to turn over and, hence, dumping the 1000 ton load. The barge was then pulled back by a tug boat and the opposite side was filled and the cycle of hauling, discharging and reloading was repeated.

To the best of my knowledge by my observations, little, if any, harm was done to fisheries and the ocean terrain. After the mines had closed, I know that fishing for halibut, crab and hooligans was done with success in the surrounding areas.

97

On the other hand, the Alaska Juneau Gold Mine was the major industry in Juneau for many years and gave a sound economy to its residents by employing about 1000 persons and stimulating supporting service businesses in the city. In addition, as indicated before, waste rock became available as land fill for the city.

Also, the mill tailings were from areas in the mine that had "minerals" of gold, silver, lead and zinc and flotation was used in the mill flow sheet. To my knowledge, no detrimental affects in the marine life resulted from these "minerals" or from the flotation process. By comparison, the U.S. Borax Molybdenum project is involved with only one metallic mineral which is planned to be recovered by flotation.

Based on the foregoing and the considerable amount of research on tailing deposition that has been done by U.S. Borax on the deposit and fully recognizing the importance of realistic environmental control and the great importance of jobs and service industries supported by the proposed mine, I re-emphasize my support for the U.S. Borsx Quartz Hill Molybdenum project and for discharge of mill tailings in Wilson Arm rather than in the greatly more expensive (capital and operating) option of using Boca de Quadre Fijords for tailing disposal.

Sincerely yours,

Earl H. Beistline

Earl H. Beistline

EHB/jc

Copies to: Governor Steve Cowper
Bob Grogan, Office of the Governor
Robert S. Burd, U.S. Environmental Protection Agency
Colonel Wilbur Gregory, U.S. Army Corps of Engineers

TEMSCO HELICOPTERS, INC.
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USDA FOREST SERVICE
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FOREST SUPERVISORS OFFICE

June 1, 1987

Mr. Win Green
Forest Supervisor
United States Forest Service
Federal Builiding
Ketchikan, Alaska 99901

Dear Mr. Green:

Mining has in the past been one of the biggest supporting industries in Alaska. However, in the last 50 years, it has dwindled to almost nothing. In the 1970's, several significant discoveries were made. U.S. Borax is one of the most important dicoveries.

The development of this mine means so much to both the State of Alaska and to the economy of Ketchikan. Presently the fishing, timber, and tourism industries are fluctuating. A fourth industry would have a very stabalizing effect on our economy.

To the best of my knowledge, U.S. Borax, on their own, has spent more money on environmental study than any other mining in the world.

Having lived in Alaska for 48 years and having been a local pilot for 44 years, I am very familiar with the area Borax is working in. I flew some of the first stream surveys of salmon in the rivers in the area. I have seen mother nature do more damage to the area than the Borax operation probably ever will. For example, a log jam blocked the Blossom River for many years, so no salmon were able to get up to spawn. Many times the Keta River has flushed out. Very slowly the fish have reestablished the run on their own. In fact, during the exploration of Quartz Hill, Hill Creek jammed up and washed out causing a thousand times more damage than a minute slide during road construction.

In conclusion, I see the Borax mine as a real bonus to the people of Ketchikan and the United States of America as well. When Wilson Arm is finally filled, it will be one of the best shellfish areas in Southeast Alaska. It is so important that Borax can develop this mine and still remain competitive in the world market. I support the Wilson Arm tailing disposal area.

Sincerely,

Kenneth C. Elchner

KCE/ank

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Dale D. Clark	Box 8738 Ketchikan, AK 99901	15	Dale D Clark
Cynthia M. Price	RT. 2, 54C Vista Dr. Ketchikan, AK 99901	29	Cynthia M. Price
Michael P Newbury	BOX 5704 KETCHIKAN AK 99901	15	[illegible]
KEN D. LINDER	Rt. 1, Box 879 KETCHIKAN, AK 99901	20	Ken Linder
Shelley Zaugg	Rt. 1 Box 854 Ketchikan, alaska 99901	1	Shelley M. Zaugg
Jill M Zaugg	354 Edmonds Ktn. AK 99901	26	Jill M Zaugg
Timothy J Montgomery	3514 Arnold st Ktn AK	21	Timothy J Montgomery
Tom Corbett	4706 Grumman St. Anchorage, Ak. 99507	4	Thomas J. Corbett Jr.

98

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Bob Engelbrecht	1255 Fritz Cove Rd Juneau, Ak. 99801	8	Bob Engelbrecht
GARY B DAHLEN	1650 MAPLESDEN WAY JUNEAU AK 99801	5	Gary B Dahlen
Heather A Burford	P.O. Box 210189 Auke Bay, AK 99821	20	Heather A Burford
DENISE HEALEY	BOX 33316 JUNEAU, AK 99803	34	Denise Healey
Jim Acher	1650 MAPLESDEN WAY JUNEAU, AK 99801	7	Jim Acher
TOM MULLIN	8739 HAYSWAY JUNEAU, AK.	29	Tom Mullin
JEFF ANDERSON	1650 MAPLESDEN WAY JUNEAU, AK	4	J Anderson
William R Curry	4196 Taku Blvd. Juneau, AK. 99801	8	[illegible]
Peter G. MacDougall	6590 Glacier Hwy #255 Juneau, AK. 99801	6	Peter G. MacDougall
[illegible] Tunney	1650 Maplesden Way Juneau, AK 99801	2	[illegible] Tunney
Dwight Schwebke	1[illegible] Bonnie Doon Juneau AK 99801	4	Dwight B Schwebke
Mike Pearson Mike Pearson	1650 MAPLESDEN WAY JUNEAU, AK 99801	1	Mike Pearson
Richard D. Rountree Richard D Rountree	1860 Fritz Cove Rd. Juneau, AK 99801	20	Richard D. Rountree
Timothy A. P[illegible]ransom T. A. P[illegible]	1650 Maplesden Way Juneau, AK 99801	1	[illegible]

98

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Earl L Walker [illegible]	Box 529 Petersburg Ak.	56	Earl L Walker
[illegible] E. Beck	P.O. Box 1464 Haines, AK 99827	14	[illegible] E. Beck
MICHAEL E CONRAD	P.O. Box 5037 KETCHIKAN AK	13	Michael E Conrad
Jim Kosmos Jim Kosmos	PO Box 8184 Ketchikan AK	8	Jim Kosmos
DOUGLAS R. [illegible]	[illegible] GROVE ST. [illegible] RENO, NV 89509	2	Douglas R [illegible]
Reggie Hunt	2[illegible] Taylor N SEATTLE	6	[illegible]
Jim Jensen	3027 Rampart Dr Anchorage	18	[illegible]
Ken Taylor	Box 1687 Petersburg AK	8	Ken Taylor
Diana Malcom	PO Box 1152 Petersburg	5	Diana Malcom

0-76

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE 98
Timothy R. Golleen	1249 Tongass, Ketchikan	9	T.R. Golen
Susie Robb	Box 6033 Ktn	7	Susie Robb
ERNEST E. Robb	Box 6033 , Ktn	7	Ernest E. Robb
Rolf Lanzendorfer	412-A Front, KTN	1	R.W. Lanzendorfer
James F. HALL	Pouch L.I. Ketchikan, Ak	20	James F. Hall
Gerald R. Baker	2415 Hemlock St. P.o. Box 8402	7	Gerald R. Baker
Nick Cain	319 N. SPRUCE Ketchikan AK 99901	8	Nicholas Cain

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE 98
W. MICHAEL STANTON	P.O. BOX 101652 ANCHORAGE, AK 99901	2	W. Michael Stanton
RC Mendenhall	Ketchikan AK	2	R C Mendenhall
ALBERT V. JONES	730 CANYON Rd. Ketchikan, AK 99901	14	Albert V. Jones
KERRY DENMAN Kerry Denman	P.O BOX 8442 KETCHIKAN AK 99901	1	Kerry Denman
~~Glenn A. Elliott~~ GLENN A. ELLIOTT	311 AUSTIN Ketchikan, AK. 99901	18	Glenn A. Elliott
Roy Hornbaker	PO 9368 Ketchikan, Ak	19	Roy [illegible]
Phil Blanks	PO 7751 Ketchika AK	4	Phil Blanks
Juaneta Cannon	Rt 1 Box 337-A Ketchikan AK 99901	10	Juaneta Cannon

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DAVID HERBIG	Box 434 SKAGWAY AK. 99840	4	David Herbig
Gina Courtright	Box 117 Skagway, AK 99840	21	Gina Courtright
Joe Hicks	Box 434 SKAGWAY AK 99840	9	Joe Hicks
Jim HUFT	Box 434 Skagway AK 99840	1	Jim Huft
Mary A. Moe	Box 218 Skagway AK 99840	20	Mary A. Moe
PAMELA J CASHEN	Box 404 SKAGWAY, AK	23	Pamela J Cashen

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Carmencita Riley	P.O. Box 210414 Auke Bay, AK 99821 15860 Glacier Hwy Juneau	3	Carmencita Riley
Lisa K Brown	P.O. Box 210554 Auke Bay, AK 99821	4	Lisa K. Brown
Kristy Stubbs	POB 34165 Juneau, AK	1	Kristy Stubbs
Julie Hamilton	P.O. Box 32051 Juneau, AK 99803	21	Julie Hamilton

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Laurie Bengaard	3305 Baranof Ketchikan, Alaska	42	Laurie Bengaard
Quincy Jarvis	Rt. 1, Box 935B Ktn.	7	Quincy Jarvis
Tom Craig	953 Lincoln KTN	22	Tom Craig
Jodi Anderson	Box 5742 Ketchikan, AK 99901	3	Jodi Anderson
Susan K Janke	PO Box 5411 Ktn, AK 99901	23	Susan K Janke
Cheryl Newman	RR # 1 Box 706 Ketchikan, AK 99901	15	Cheryl Newman
JOAN MARTIN	BOX 636 WARD COVE, AK 99928	37	Joan Martin
Patricia G. Rusher	2542 - 4th Ave. Ketchikan, ak 99901	27	Patricia G. Rusher
Shelegh A. Kasinger	P.O. Box 3169 Ketchikan, AK	12	Shelegh A Kasinger
Maura Odell	Rt 1 Box 959 Ketchikan, Ak.	30	Maura Odell
RALPH YETKA	Box 958 WARD COVE AK	15	[illegible]
Karl Richter	BOX 7935 KETCHIKAN, AK.	10	Karl Richter
Steven M. Brown	BOX 9317 KETCHIKAN AK	6	Steven M. Brown
Timmy Kuhn	4820 LEAH CT ANCHORAGE 99508	2	[illegible]
CHARLES W. GALE	PO BOX 6573 KETCHIKAN AK 99901	10	[illegible]

Q-70

TEMSCO HELICOPTERS, INC.
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OR 225-4583
PETERSBURG (907) 772-4780
WRANGELL (907) 874-2010
JUNEAU (907) 789-9501
TELEX 099-55204

June 9, 1987

Mr. Win Green
Foreet Supervieor
Foreet Service
United Stetee Dept. of Agriculture
Federel Building
Ketchiken, Aleske 99901

Re: Quertz Hill Molybdenum Project

Deer Mr. Green

Encloeed ere e couple more eignature eheete thet we received e little lete. I hope they will help us to eucceed in getting U.S. Borex sterted.

Sincerely,
TEMSCO Helicopters, Inc.

Shelegh Kasinger

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PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Baxter, Samuel R.	Thorne bay Ranger Dist Box 1 thorne Bay	2	Samuel R. Baxter
Tempa, David	P.O. 232 Thorne Bay	3	David Tempa
Staples Donald	416 Shoreline Dr Thorne Bay AK	10	Donald J Staples
Staples John	416 Shoreline Dr Thorne Bay AK	10	John Staples
McKenney, Patricia	P.O. Box 341 Thorne Bay AK 99919	8	Patricia L. McKenney
Elvin Clutcher	P.O. Box 349 TNB	4	Elvin Clutcher
Bill MacCaull	P.O. Box 19433	17	William R MacCaull
Lynn Nicholson	Box 19442	6	Lynn M. Nicholson
Nicholas A Gehe	Box 19172	10	Nicholas A Gehe
Hamilton, Ruth	Box 177	13	Ruth S Hamilton
Java, Pete	834 Water St. Ketch AK	10 yrs	Pete Java
Lonnie Brumfield	PO Box 591 Thorne Bay AK 99919	7 yrs	Lonnie Brumfield Jr
Jack Sims	Po Box 158 Thorne Bay AK 99919	5 yrs	Jack Sims
Tom Beck	P.O. Box 328 Thorne Bay	30	Tom Beck

98A

PRINT NAME	PRINT ADDRESS	YEARS IN ALASKA	SIGNATURE
Eric Hope	PO Bx 292 Thorne Bay AK	3	Leonard Eric Hope
Sharon Horne	P.O. Box 19491 Thorne Bay, AK.	1	Sharon Horne

99

TJM

Mr. Win Green   June 2, 1987
Forest Supervisor, Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, AK. 99901

Dear Sir:

The U.S. Borax Quartz Hill Project is of vital importance to America and the State of Alaska in that it is high time for the development and production of minerals on our own soil.

For U. S. Borax to succeed in its project, it is also necessary to keep production cost effective which in itself dictates that environmental controls must be reasonable and not prohibitive. This project must be able to compete with world markets.

For this reason I support U. S. Borax's position of the tailings disposal site, namely, Wilson Arm/ Sweaton Bay.

Sincerely,

Thomas J. Miklautsch
P. O. Box 1
Fairbanks, AK. 99707-0001

xc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

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Alaska State Legislature

PRESIDENT
907-465-3755

JAN FAIKS
POST OFFICE BOX V
JUNEAU, ALASKA 99811

Senate

June 3, 1987

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Mr. Win Green, Forest Supervisor
United States Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

On behalf of the Alaska Senate, I want to share with you its firm commitment to the future of our state and individual citizens. One of the keys to achieving a better future for individual Alaskans is economic development and diversification.

For this reason I believe it is crucial that the U.S. Borax Quartz Hill Molybdenum Project be undertaken. This project can be completed in an environmentally sound manner which effectively balances environmental concerns with economic realities. Economic development and environmental responsibility are not mutually exclusive, as has been demonstrated so well in the design of this project. I am confident that this fact will continue to be taken into account in the final regulatory decisions made by your agency, and that approval will be granted without unnecessary and duplicative stipulations.

The social and economic future of our state depends on successful developments such as the U.S. Borax Quartz Hill Project.

Sincerely,

Jan

Jan Faiks
Senator

CC: Robert S. Burd, Environmental Protection Agency
Colonel Wilbur Gregory, Corps of Engineers
Bob Grogan, Division of Governmental Coordination
D. L. Finney, U.S. Borax Quartz Hill Project
Senator Lloyd Jones

OUT OF SESSION
6060 YUKON DRIVE   ANCHORAGE, ALASKA 99516   907-274-6611

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5/29/87

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Mr Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Ak 99901

Dear Mr. Green:

I am writing concerning the Quartz Hill Molybdenum project. The way I understand it U.S. Borax prefers tailings disposal in Wilson Arm/Smeaton Bay as appose to Boca de Quadra. They claim that they can save as much as 6% of the cost of building the plant. Of what I have seen, the Forest Service sees little difference in the effect on these two fjords from the tailings.

My brother-in-law recently lost his job in Anchorage due to the poor economic condition. For his sake and other Alaskans, please support U.S. Borax in its effort.

[signature]

ROBERT BATES, JR.
18242 LARKSPUR RD.
ADELANTO, CA 92301

COPIES TO: MR. ROBERT S. BURD
COLONEL WILBUR GREGORY
MR. J.J. GROGAN

Q-82

102

ROBERTSON, MONAGLE & EASTAUGH
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
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JUNEAU, ALASKA 99802-1211

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MICHAEL T. THOMAS
LEROY J. BARKER
** L. O. BERRY
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** CARL W. WINNER
SUSAN M. WEST
** JULIA B. BOCKMON
JOSEPH D. DARNELL
GREGORY O. SILVEY
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STEVEN W. SILVER

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OF COUNSEL
F. O. EASTAUGH

R. E. ROBERTSON (1885-1981)
M. E. MONAGLE (1902-1985)
JAMES F. CLARK
PAUL M. HOFFMAN
O. ELIZABETH CUADRA **
JAMES M. SHINE
PAMELA FINLEY
THOMAS J. SLAGLE

* ADMITTED IN WASHINGTON, D.C.
** ADMITTED IN WASHINGTON, D.C. AND ALASKA
ALL OTHERS ADMITTED IN ALASKA

June 3, 1987

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Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill Mine Development:
Revised Draft Environmental Impact Statement (RDEIS)

Dear Win:

I would like to applaud the Forest Service for proposing the Wilson Arm-Smeaton Bay proposal for disposal of mine tailings from the proposed Borax mine. In my opinion, the RDEIS conclusively shows that all of the detrimental impacts that could arguably be associated with Boca de Quadra disposal would be avoided by the Wilson Arm-Smeaton Bay alternative. Equally important to my mind is the fact that it would reduce the costs of operations so that this project can go forward. This project, in my opinion, is critical to the financial well-being of the people of Southeast Alaska. Given the minimal environmental impact in the major socio-economic benefits to be derived, let me not only express my support for the Wilson Bay-Smeaton Bay alternative, but urge the Forest Service to move through this process as expeditiously as possible so that they can get on with this project to the benefit of all of us in Southeast Alaska.

Very truly yours,

[signature]

James F. Clark

JFC:sd/10.17

103

June 2, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U. S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

RE: Quartz Hill Mine

Dear Mr. Green:

This letter is in response to the public invitation for comment on the recent Revised Draft Environmental Impact Statement for the Quartz Hill Mine Development.

As a life long Alaskan and as the information officer of the Alaska Department of Labor for eight years, I have followed the progress of this proposed mining development for some years. I offer these comments as a citizen of the state and not in my official capacity.

I would like to indicate my support for the project and that it proceed in a way that is economically sound and still recognizes the environmental concerns in a reasonable manner. Based upon all that I have seen, I would urge you and others to proceed with the Wilson Arm-Smeaton Bay site for disposal of tailings. All that I have seen indicates that this is the most feasible from a cost standpoint and that we could well see an enhanced shellfish fishery in the long term.

It makes no sense to me to suggest the Boca de Quadra alternative due to its extremely high cost and further that the Wilson Arm site has everything going for it. It is clear to me, as an observer since this project was first proposed, that the economic benefits to Southeast Alaska far outweight the negative impacts suggested by some who oppose the project.

Thank you for your moving ahead with the approvals necessary to ensure that this project is realized.

Sincerely yours,

J. Allan MacKinnon
P.O. Box 32760
Juneau, Alaska 99803-2760

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JUN 3 '87
FOREST SUPERVISORS OFFICE

104

1500 Eastgate Dr., Ste 110
Garland, TX 75041

June 2, 1987

Subject: Alaska Molybdenum
Quartz Hill

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green,

As a citizen concerned with both the economics and the ecology of our great nation, I have read and studied with much interest the comments and research regarding the proposed subject mining venture. The state of Alaska, the Pacific Northwest and, indeed, the entire United States will benefit from the development of this project, which will assure our independence in a potentially strategic mineral for generations to come.

It would appear the economic viability of this project hinges on the disposal of the mine tailings at a reasonable cost. The environmental impact studies indicate the Wilson Arm of Smeaton Bay to be the superior choice satisfying both economic and environmental constraints.

The United States became a world economic power through capitalism by allowing our entrepreneurs the right to develop our resources for internal consumption and foreign trade. Our habitat and environment are important concerns, however, their preeminence will retard and eventually strangle our economy.

T. R. Dunn

TRD/dk

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

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JUN 3 '87
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105

105

June 2, 1987
12 Silver Saddle Ln.
Rolling Hills Estates
CA 90274

Dear Mr. Green,

I have reviewed the Summary, Quartz Hill Molybdenum Project, Mine Development. Some 30 ~~years~~ ago, I was engaged in Mineral Exploration in Southeastern Alaska with our base in Ketchikan. It is with pleasure I note that at long last, a genuinely major significant project will soon be undertaken by U.S. Borax at Quartz Hill. A major project like this one has a long and favorable impact on the local community (Ketchikan) and the entire region.

#1

I favor the use of Wilson Arm for tailings disposal. Every dollar that can be saved in the development of the mining project aids in overall viability. In my view the EPA arguement is specious. The principal criticism of the EIS document (all documents) is the need to predict the future. We all know that this is at best inexact and at worst impossible. Surely, any concerns about problems of material accumulating above 100 m depth must be addressed in later years. The final EIS should have sufficient flexibility in its conditions to allow for changes in tailings considerations and other considerations as they change with time.

For Quartz Hill to be competitive, every reasonable attempt to lower costs must be considered, and incorporated in the production plan when warranted. This project could serve as a National Model for and of cooperation between Federal, State and local Agencies and private enterprise.

Southeastern Alaska is on the threshold of a new era in mining. With success at Quartz Hill, other mines will be found and carried to production.

Again, I favor the use of Wilson Arm for tailings disposal, and the working together of Government and private enterprise to further the economic future of Southeastern Alaska.

Sincerely
Charles J. Kurdest

106

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June 3, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U. S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Re: Quartz Hill Project

Dear Mr. Green;

I support the Quartz Hill Project but realize that it can only be placed into production if the capital and operating cost are kept low consistent with miminum damage to the environment. Placing this major project into production will benefit the economy of the region.

Two specific areas which increase the costs concern me. The first are the alternatives requiring a long tailings tunnel to the Boca de Quadra fjord so that the tailings can be discharged into another portion of the ocean. It is very difficult to understand the need for the increased capital and operating cost of the long tunnel when only a minor increase in environmental safety occurs because of the greater depth of the Boca de Quadra fjord. Also to be considered when using the Boca de Quadra fjord are the environmental impacts created by adding the necessary access roads and supporting infrastructure to utilize this area. Using the Wilson Arm disposal area would concentrate the vast majority of the environmental impact in one drainage area.

The second area of concern is the environmental impact of the greater reservior surface area behind a single high dam water source on Tunnel Creek. The proposal to use a low dam, with a smaller reservior surface area, combined with a backup water supply from a well field or pump station from the Wilson Creek area would be a lower cost solution and probably result in less surface area environmental impact.

Again I support this project but in order for this project to provide a stable economic contribution to this remote area the initial capital cost and the operating cost must be low.

Sincerely,

Charles Sorvisto

Charles Sorvisto
2324 Sylvan Lane
Glendale, CA 91208

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

107

JUNE 5, 1986

DEAR MR. WIN GREEN:

I AM SURE THAT YOU ARE AWARE THAT YOUR SUPPORT FOR THE QUARTZ HILL PROJECT AND FOR SELECTION OF THE ECONOMICALLY FAVORED TAILINGS DISPOSAL SITE, NAMELY WILSON ARM/SMEATON BAY, COULD HELP BRING THOUSANDS OF JOBS TO KETCHIKAN AND THE STATE OF ALASKA. WE NEED ALL THE JOBS POSIBLE AS SO MANY HAVE BEEN SENT OVERSEAS. ANOTHER BENEFIT TO OUR COUNTRY THE EXPORT OF MOLYBDENUM WOULD CONTRITE TO OUR NATIONAL BALANCE OF PAYMENT.

SO I SAY THE QUARTZ HILL PROJECT IS GOOD FOR SOMANY INDIVIDUALS AND SO MANY GOVERNMENTS. SO MAY I COUNT ON YOUR SUPPORT OF THE QUARTZ HILL PROJECT.

SINCERLY AND THANKS

Harwell J. Sleet

Harwell J. Sleet
7463 E. Covey Drive
Tucson, AZ 85715
(602) 577-1218

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R.D. 4, Box 348
Canton, N.Y. 13617
June 5, 1987

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Mr. Win Green, Forest Supervisor
Ketchikan Area
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

This is in reference to the EIS on the Quartz Hill mine development.

From all collected information on the impact of this project on the quality of the natural unexploited environment, there can be no doubt that if allowed to proceed, there will be irrevocable damage to fish, wildlife and recreational potential of the entire area. It is a cancer on the face of one of the most scenic, special areas in the United States as presently planned.

The size of the projected area is excessive in the extreme and should be reduced by at lease sixty percent. Instead of using the sea as a dumping ground the spoil should be temporarily stock-piled and used to fill as much of the enormous hole as possible, that is inevitable. #1

The word "mitigate" as used in the EIS obviously means "the project will go forward regardless of the damage to all other values."

The balance between extracting a non-renewable resource and protecting many renewable natural resources in perpetuity is not indicated in the EIS as it should be. The apparent priority is to provide a private corporation with maximum financial gain at the expense of the public land lost.

Permits to proceed with this project should not be granted unless the above indicated revisions are made and the public interests are better served.

There are other molybdenum deposits in the world but there ~~there~~ is no other Misty Fjord National Monument or an area of comparable ecological significance that could be used in place of it.

Sincerely,

Clarence Petty
Clarence Petty

cc. U.S.Army Corps of Engineers
Alaska District

109

CAPITAL OFFICE SUPPLY
1946
P.O. Box 39, Suite 12 - Juneau, Alaska 99802 - (907) 789-1366

June 6, 1987

Mr. Win Green
Forest Supervisor
United States Department Of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I am writing to you in support of the U.S. Borax Quartzhill Project located in the Ketchikan area.

I am an Alaskan business who has been operating in Southeast Alaska since 1946. My young son is a forth generation Alaskan, and I want to see responsible growth and development of our resource potential for this generation as well as the next. I could go on and on regarding the positive economic impact we can receive from projects such as these.

I am in favor of this project, and the location selected for the Wilson Arm/Smeaton Bay disposal site.

Yours truly,

T.C. "Terry" Quinn
President & General Manager

cc: Mr. Robert Burd-U.S. E.P.A.
Col. Wilbur Gregory-U.S. Corps Of Eng.
Mr. Bob Grogan-Offc Of The Gov. State Of Ak.
Ketchikan Chamber of Commerce

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City of Ketchikan

334 Front Street
Ketchikan, Alaska 99901
907-225-3111

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June 8, 1987

Mr. Win Green
Forest Supervisor
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

During its June 4, 1987 regular meeting, the Ketchikan City Council passed and approved Resolution No. 87-1512, a resolution regarding the City of Ketchikan's review of the Revised Draft Environmental Impact Statement for the U.S. Borax and Chemical Corporation development of the Quartz Hill Molybdenum deposit. A copy is enclosed for review and consideration by your agency.

If you have questions, please contact me.

Sincerely,

James A. Van Altvorst
City Manager

JAV:cs
enclosure

cc w/enclosure

Director, Water Division, Region X, U.S. Environmental Protection Agency
District Engineer, U.S. Army Corps of Engineers
Director, Division of Governmental Coordination, Office of the Governor

USB9999995/LETTERJAVA/MGRLIB

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THE CITY OF KETCHIKAN ALASKA

RESOLUTION NO. 87-1512

A RESOLUTION OF THE COUNCIL OF THE CITY OF KETCHIKAN, ALASKA, REGARDING THE CITY OF KETCHIKAN'S REVIEW OF THE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE U.S. BORAX AND CHEMICAL CORPORATION DEVELOPMENT OF THE QUARTZ HILL MOLYBDENUM DEPOSIT, AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, U.S. Borax and Chemical Corporation (U.S. Borax), acting on behalf of its affiliate, Pacific Coast Molybdenum Company, has submitted a Plan of Operations to develop a molybdenum mine to the U.S. Department of Agriculture, Forest Service, Tongass National Forest; and

WHEREAS, the proposed project, known as the Quartz Hill Molybdenum Project, is located approximately forty-five (45) air miles east of Ketchikan in the Misty Fjords National Monument; and

WHEREAS, the Forest Service has determined that an Environmental Impact Statement (EIS) is required to support federal action on the Plan of Operations and that issuance of required permits and leases would be major federal actions significantly affecting the human environment; and

WHEREAS, the Forest Service has determined that an Environmental Impact Statement (EIS) is required to support federal action on the plan of Operations and that issuance of the permits and leases by the Forest Service, the Corps of Engineers, and the Environmental Protection Agency (EPA) would be major federal actions significantly affecting the human environment; and

WHEREAS, this decision was made pursuant to the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA; and

WHEREAS, as required by the final regulations implementing NEPA, the Forest Service has provided a process to determine the scope of issues to be addressed and to identify the significant issues related to the proposed project; and

WHEREAS, the Forest Service accomplished this by forming an interdisciplinary team (IDT) comprised of representatives from public agencies and U.S. Borax and by holding a public meeting; and

WHEREAS, following development of the scope of work, the U.S. Forest Service contracted with Envirosphere to prepare the environmental impact statement; and

WHEREAS, a draft EIS on the project was published and distributed by the Forest Service on July 27, 1984; and

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WHEREAS, as required by federal regulations, a public hearing was held on September 6, 1984, on that Draft Environmental Impact Statement (DEIS); and

WHEREAS, October 5, 1984, was the deadline for submitting formal written comment on the DEIS; and

WHEREAS, then-City of Ketchikan Mayor Edward W. Zastrow made a brief presentation at that hearing expressing reservations about the adequacy of the DEIS to properly address the socio-economic impacts of the proposed mine on the Ketchikan community; and

WHEREAS, at a joint meeting held on October 4, 1984, the City Councils of the cities of Ketchikan and Saxman and the Ketchikan Gateway Borough Assembly unanimously passed a motion to submit a joint resolution transmitting to the U.S. Forest Service their written comments on the DEIS; and

WHEREAS, by Resolution No. 1404, passed on October 4, 1984, the City of Ketchikan joined with the City of Saxman and the Ketchikan Gateway Borough to adopt the reports prepared by the staffs of the three local governments regarding the DEIS for the Quartz Hill Molybdenum project mine development; and

WHEREAS, pursuant to that Resolution, the City of Ketchikan submitted its comments jointly with the City of Saxman and the Ketchikan Gateway Borough to the U.S. Forest Service; and

WHEREAS, as a result of changes in the proposed project and the development of new data since the DEIS, the Forest Service decided to prepare a revised draft EIS (RDEIS) before issuing a final EIS; and

WHEREAS, the City of Ketchikan recently received that RDEIS for review and comment; and

WHEREAS, EPA and the Forest Service have requested reviewers of the RDEIS to submit new information, if any, which would help in assessing the potential impacts of the proposed project; and

WHEREAS, the City of Ketchikan has completed its review of the RDEIS and desires to provide the results of that review to the U.S. Forest Service.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF KETCHIKAN, ALASKA AS FOLLOWS:

Section 1. The City Council of the City of Ketchikan hereby finds and declares that the socio-economic portions of the Revised Draft Environmental Impact Statement contain fair and reasonable

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descriptions of the local socio-economic environment as of the time the data for the RDEIS were collected.

Section 2. The City Council of the City of Ketchikan further finds and declares that the assumptions and conclusions contained in the socio-economic portions of the Revised Draft Environmental Impact Statement should provide a reasonable basis for the City of Ketchikan to work with the U.S. Borax and Chemical Corporation to mitigate the socio-economic impacts resulting from the development and operation of the Quartz Hill Molybdenum mine project on this community; provided, however, that the City Council of the City of Ketchikan requests the U.S. Forest Service to recognize that changing times and circumstances could materially affect the conclusions contained in the RDEIS, thereby rendering portions of the RDEIS invalid; and that, if such circumstances occur, the City Council of the City of Ketchikan requests the U.S. Forest Service to give full and reasonable consideration to the need to review and revise those decisions and permits which were based on the final EIS in light of such circumstances.

Section 3. The City Council of the City of Ketchikan hereby authorizes and directs the City Manager to submit this resolution to the U.S. Forest Service on its behalf.

Section 4. This resolution shall be effective immediately upon passage.

PASSED AND APPROVED THIS 4th day of June, 1987.

Ted Ferry
Ted Ferry, Mayor

ATTEST:

Karen Miles
Karen Miles, CMC
City Clerk

RES8799998/RESOLUTION/MGRLIB

111

June 14, 1987

Win Green - USFS
Federal Bldg.
Ketchikan, AK 99901

In regard to the U.S. Borax mine development, I am very much opposed to any development in the Wilson Arm. Wilson is a very important fish stream & as a Power Troller in S.E., & as a resident (year-round) who fishes these waters & enjoys their ~~[illegible]~~ scenic beauty I am opposed to this exploitation.

Please tell Borax to use Boca de Quadra, <u>NOT</u> <u>Wilson Arm</u>.

Its important to my life, my living & most important, my children!!

Kim Betzina's family

Kim J. or Sue C. Betzina
F/V Bold Venture
Post Office Box #26
Point Baker, AK 99927

112

Robert C. Munro
6704 Julie Lane
West Hills, California 91307

June 9, 1987

Win Green
Forest Supervisor
Tongass National Forest
Ketchikan Area
Federal Building
Ketchikan, Arkansas 99901

Dear Mr. Green:

Mineral wealth is so important, so rare and concentrated in such small areas of the earth's surface that it should be apparent to most that the development of a project such as Alaska's Quartz Hills is of great importance to the state and the nation.

Most nations would be doing all in their power to aid and foster the development of such a resource in the best and most logical fashion.

The Forest Service Preferred Alternative seems to be trying to do this. The development of the project with it's tailing areas in one impact area provide the best and possibly the only route to sensible economic development of the project.

Very truly,

Robert C. Munro
Registered California Geologist #002084

RCM/fd

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3920 San Marcos Court
Newbury Park, California 91320

June 9, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Win:

Over the last several years, I have been watching with interest the development of the Quartz Hill Molybdenum Project by U.S. Borax & Chemical Corporation. Prudent development of this natural resource could have significant social and economic impacts upon the Ketchikan area and Alaska as a whole. However, it is becoming obvious that these benefits will only be reaped if Quartz Hill can be developed as a low-cost, competitive source of molybdenum. For this reason, I wholly support the economically favorable proposal for tailings disposal in Wilson Arm/Smeaton Bay.

As in all resource development, there must be a balance between protection of the environment and potential socio-economic benefits. The marginally greater environmental safety afforded by the greater depth of Boca de Quadra is overshadowed by all of the advantages which Wilson Arm disposal could provide in terms of making the Quartz Hill project a viable enterprise.

Thank you for your consideration. Please support the Forest Service preferred alternative for tailings disposal in Wilson Arm.

Sincerely yours,

J. D. Larimore

J. D. Larimore

JDL/pm

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental
Protection Agency
1200 Sixth Ave.
Seattle, WA 98101

Colonel Wilbur Gregory
District Engineer
U.S. Army, Corps of
Engineers
P. O. Box 898
Anchorage, AK 99506-0898

Mr. Bob Grogan,
Director
Office of the Governor
Division of Governmental
Coordination
Pouch AM
Juneau, AK 99811

114

FAIRBANKS DISTRIBUTORS
P.O. BOX 485
FAIRBANKS, AK 99707

June 9, 1987

TO: Mr. Win Green

RE: Support of Quartz Hill Project and Wilson Arm Tailing Bed.

Dear Mr. Green:

I would like to go on record as a supporter of the U.S. Borax Quartz Hill Project. It appears U.S. Borax has complied with all necessary environmental restoration imposed in order that this project not be a detriment to our State.

Additionally, I support the Wilson Arm as a dumping bed for the tailings from the mine operations as opposed to the Boca de Quadra Arm. This format appears to offer an acceptable balance between economic and environmental consideration.

Thank you for the opportunity to present this written testimony.

Sincerely yours,

Gary Wilken

GW/kjr

~~cc: See Attached (3)~~

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ALASKA STATE LEGISLATURE

Home Address
3813 Denali Street
Ketchikan, AK 99901
907-225-9082

While in Juneau
P.O. Box V
Juneau, AK 99811
907-465-3743

Senator Lloyd Jones

June 10, 1987

Mr. Win Green, Forest Supervisor
United States Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I feel it is important for me to express to you my concern for the long term health and stability of our local and state economy. The key to achieving a better economic environment is the continued development of our natural resources.

The U.S. Borax Quartz Hill Molybdenum Mine will be an essential project in Ketchikan's pursuit of economic diversification and stability. U.S Borax has shown that this undertaking can be completed in an environmentally sound manner while living up to economic realities. I am confident you will take this into consideration while forming the final regulatory decisions made by your agency. I hope that approval of this project will be granted without undue restrictions.

Ketchikan's future relies on the successful implementation of projects such as the U.S. Borax Quartz Hill Project.

Sincerely,

Lloyd

Lloyd Jones

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JUNE 3, 1987
P.O. Box 2106
SITKA, AK. 99835

FOREST SERVICE
KETCHIKAN RANGER DISTRICT
3031 TONGASS
KETCHIKAN, AK. 99901

SUBJECT: QUARTZ HILL MINE IN KETCHIKAN

DEAR PUBLIC SERVANT,

I WOULD LIKE IT TO BE KNOWN THAT I AM ADAMANTLY OPPOSED TO THE DUMPING OF MINE TAILINGS INTO WILSON ARM.

YEARS OF CAREFUL STUDY & CONCERNED EFFORT SHOULD NOT BE OVERTURNED FOR THE SAME OF EXPEDIENCY. THIS HAS HAPPENED TOO MANY TIMES WITHIN THE STATE OF ALASKA.

MISTY FIORDS SHOULDN'T BE VIOLATED WITH AN "ABOVE THE GROUND PIPE LINE" JUST SO THAT A FEW INDIVIDUALS CAN MAKE A FEW MORE DOLLARS PROFIT.

Florian Sever

THE ALLIANCE

P.O. Box 100100 / Anchorage, Alaska 99510 / (907) 278-4444

June 5, 1987

Mr. Win Green
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

You and your staff are to be commended for an excellent work product - the revised Draft Environmental Impact Statement for the Quartz Hill Molybdenum Project. We understand the effort it takes to produce a document of this nature and respect the professionalism you and your group have demonstrated in adhering to the findings on which to base your conclusions.

Several of our members who are familiar with the proposed project and with the area in which the project is to be located underscore your conclusions that the Wilson Arm/Smeaton Bay alternative is the most prudent option for tailings disposal. As you point out, there will be little difference in the environmental impacts of tailings disposal in the marine environment between the Wilson Arm fjord and the Boca de Quadra fjord. In either instance, appropriate mitigation measures point to the viability of the project.

Given those findings, your conclusion that Ketchikan and Southeast Alaska would benefit from greater socio-economic stability in the Wilson Arm scenario, is logical and is to be applauded. With the intense competetion associated with global molybdenum markets, authorization of project variables must be directed to cost reduction alternatives if that can be done with minimum environmental insult.

We trust that these observations, along with those of other thoughtful groups and persons, will permit U.S. Borax to proceed expeditiously with development of the important mineral resource.

Sincerely,

ALASKA SUPPORT INDUSTRY ALLIANCE
Chuck Becker
Vice President

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Alaska Support Industry Alliance
. . . for responsible economic development

"PLACE OF MANY PLACES"

Chugiak-Eagle River Chamber of Commerce

P.O. Box 770353 / Eagle River, Alaska 99577

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June 5, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Green:

The Chugiak-Eagle River Chamber of Commerce, an organization of 120 community and business leaders, would like to take this opportunity to comment on the reissue of the Draft Environmental Impact Statement for the U.S. Borax Quartz Hill Molybdenum Project.

We have reviewed the Draft Environmental Impact Statement and overwhelming support the preferred alternative for tailings disposal in the Wilson Arm. This seems to us to strike the best balance between environmental concerns and the socioeconomic needs of the area. Since the environmental differences between the two fjords are small we feel that confining the activity to Wilson Arm makes good sense. The advantages of such a decision are obviously since it would restrict activity to one fjord thus minimizing the impact on the pristine wilderness of Misty Fjords National Monument. The ANILCA requirements and those monitoring activities required by the permitting process will insure protection of the environment.

Never has the need for Alaska to supplement and diversify its oil dependent economy been greater than now. The U.S Borax Quartz Hill Molybdenum Project is but one step in that direction. With reasonable environmental controls, allowing U.S. Borax to place tailings in Wilson Arm Fjord will insure that the project can be competitive in the world market place.

Thank you for the opportunity to comment on this important issue.

Sincerely,

Steven R. Punch
President

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June 5, 1987

Mr. Win Green
Forest Supervisor
USDA Forest Service
Federal Building
Ketchikan, AK 99901

Re: Quartz Hill, Revised Draft EIS

Dear Mr. Green:

Sealaska Corporation supports the U.S. Forest Service's preferred alternative for development of the Quartz Hill molybdenum mine.

Sealaska has reviewed the Revised Draft EIS and we have concluded that the socioeconomic, aesthetic and ecological considerations favor a Wilson Arm tailings disposal site versus the Environmental Protection Agency's (EPA) preferred site in Boca de Quadra. The EPA's concerns with the Wilson Arm site focus upon future potential effects that would not be a factor for at least fifty years of the mine's projected fifty-five year life. U.S. Borax acknowledges that they could be required to suspend operations if EPA's worst case fears were to become reality; yet they prefer the Wilson Arm alternative. Clearly, U.S. Borax's environmental scientists are confident that they can mitigate any perceived detrimental effect upon the environment that may be associated with the Wilson Arm alternative. #1

Sealaska's position on the Quartz Hill project is that it is preferrable to confine environmental impact, management responsibility and monitoring requirements to one ecosystem. In this case, the Wilson River drainage. We do not feel that the Boca de Quadra site offers such a compelling alternative.

The socioeconomic impacts of the significantly lower capital and operating costs of the U.S. Forest Service alternative are adequately documented in the Revised Draft EIS and need no further comment here. The added costs of the Boca de Quadra disposal will determine not only when, but if, Quartz Hill ever becomes a mine. Sealaska urges your continued support for the U.S. Borax project and finalization of decision-making for tailings disposal in Wilson Arm. Thanking you for this consideration.

Sincerely,

SEALASKA CORPORATION

Robert W. Loescher
Senior Vice President
Resource Management

RWL/PG:mt

cc: Robert S. Burd, EPA
Joseph Chomski, Esq.
Don Finney, ALA
Paul Glavinovich
Wilbur Gregory, COE
Robert Grogan, DGC
Sam Kito
Bart Koehler, SEACC
Janie Leask, AFN
Byron I. Mallott
Edward Thomas, THCC
Richard Stitt, ANB
Senator Jim Duncan
Senator Richard Eliason
Senator Lloyd Jones
Representative Peter Goll
Representative Ben Grussendorf
Representative Bill Hudson
Representative John Sund
Representative Robin Taylor
Representative Fran Ulmer
Senator Frank Murkowski
Senator Ted Stevens
Congressman Don Young
Sealaska Board of Directors
Southeast Alaska ANCSA Corporation Presidents
U.S. Borax

SEALASKA CORPORATION ONE Sealaska Plaza, Suite 400, Juneau, Alaska 99801 Phone (907) 586-1512

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J. ELLSWORTH "JENS" JENSEN
531 Pittinger
Ketchikan, Alaska 99901

8 June 1987

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MR. Win Green Forest Supervisor
U.S. Forest Service
Federal Building Ketchikan, Alaska
99901

Gentlemen:

Subject U.S. Borax
Quartz Hill Molybdenum Project

First I will introduce myself J. Ellsworth "Jens" ~~Jensen~~ 50 year resident of Alaska - retired business man (hardware) fisherman - guide.

I have cruised around Revilla Island Behm Canal at least 10 times each year for more than 30 years. Which means this writer is better acquainted with all the waters and bays of Behm Canal and Boca de Quadra than any other presently living person.

I will make the following recommendations

① Yes. Alaska and the entire United States needs to develop this project.

J. ELLSWORTH "JENS" JENSEN
531 Pittinger
Ketchikan, Alaska 99901

② Do not disturb Boca de Quadra leave this entire area "as is" no Tunnel or disposal site.

③ Keep all development in Wilson Arm Disposal of waste material into Smeaton Bay will not effect the andromonous fish - and may even help with species of shell fish and bottom fish.

④ I mention Smeaton Bay not Wilson Arm for disposal. Waste material should be dumped into the 100 fathom curve - near the entrance to Bakewell Arm and Wilson Arm.

My most recent trip into Wilson Bakewell was 2 June 1987 and yes I have been up the mine road and spent an entire day at the mine site August 1985. Thank you for reading my opinion.

Respectfully
Jens Jensen

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DRS. WILSON AND SALNESS, P.C.
ARTHUR N. WILSON, M.D., 1898-1983
JAMES A. WILSON, M.D., F.A.C.S.
ARTHUR N. WILSON, JR., M.D.
TY A. SALNESS, M.D.
P O BOX 8678
KETCHIKAN, ALASKA 99901

June 9, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Buiding
Ketchikan, Alaska 99901

Dear Mr. Green:

I am writing to you concerning the U.S. Borax Quartz Hill molybdenum project relevant to the published solicitation of public opinion.

I am responding as a Ketchikan resident born in Alaska, a physician practicing in Ketchikan for 25 years, a lover of the out of doors and a hunter-fisherman with a commercial fishing license and a commercial boat, which I fish personally. I am very familiar with the Quartz Hill area having spent many seasons hunting and climbing over the Quartz Hill area as well as the head of Boqua de Quadra.

I feel that the benefit of the Quartz Hill development is absolutely necessary to the future economy of the Ketchikan area. I have read the surveys and watched the development of the statements by U.S. Borax concerning the necessity for tailings disposal in Wilson Arm (Smeaton Bay) and believe that their rationale is sound. I do not believe that this will harm the area environmentally because of the mode of disposal. I believe that U.S. Borax has developed this carefully and thoughtfully with research and thought into long-range effect of tailings disposal and development.

I believe at this time that there is no reason to forestall this development by further requirements of survey, impact statements, and expensive time consuming studies, so that, as soon as economically possible, this project can go ahead to be developed to benefit this community, the state of Alaska and the general economy of our nation.

I appreciate very much this opportunity to write you and support this extraordinarily important future development which will have such far reaching benefit far into the future.

Sincerely,

Arthur N. Wilson, Jr., M.D.
Internal Medicine

ANW/mc

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6/10/87

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture

Dear Sir:

As a native-born Ketchikan Alaskan, I would like to add my support to U.S. Borax in the matter of dumping tailings in Wilson Arm.

I am familiar with the situation as it presently exists and as it previously existed. I was employed by Temsco Helicopters as a pilot when the deposit was first discovered and subsequent development began. I was also employed by South Coast Inc. (Helicopter Pilot) during the construction of the road.

I can see no logical reason to extend the impact into the Boca de Quadra area other than to burden U.S. Borax economically as a punishment for being in what some people (relatively new to this area) have come to view as a Holy site. I would urge you to do the logical thing in this case (also any subsequent cases) and allow U.S. Borax to dump the tailings into Wilson Arm.

Sincerely yours,

Cliff Kamm

Cliff Kamm
Box 6513
Ketchikan, AK 99901

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Anchorage · Star of the North
Chamber of Commerce

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June 10, 1987

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Dear Mr. Grogan:

The Anchorage Chamber of Commerce has supported over the years US Borax attempts to develop mineral holdings at Quartz Hill near Ketchikan. Today, another opportunity exists to move this project forward, and an opportunity for the Administration to step forward in support of an environmentally sound economic development. Our State officials have been too quiet in the past in support of this project. Now with the reissuance of the draft EIS supporting tailing disposal in Wilson Arm, we would hope that leaders in this Administration, including the DNR, DEC, and DF&G Commissioners, are able to take a clear and unequivocal public position favoring this project.

Our Chamber favors sound, safe development. We also favor regulatory reform. With the federal EPA approval of Wilson Arm disposal over Boca De Quadra, a statement by your Administration will go far toward easing concerns by the business community that the State will use regulations not *for* development, but as a hammer against.

415 F Street, Anchorage, Alaska 99501-2254 (907) 272-2401

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The end of the public comment period is 15 June. We hope the Administration has already taken a leadership position by personal participation. Economic development must begin from within the State, in the extraction of resources. We count on you. A copy of this letter has been sent to Mr. Win Green, Forest Supervisor, as evidence of support for Quartz Hill by the Anchorage business community.

Sincerely,

Wayne Beckwith

Wayne K. Beckwith
Executive Vice President

WKB/jas
bcc: Mr. Win Green/Forest Supervisor ✓
Mr. Robert S. Burd/Dirctor, Water Division,EPA
Colonel Wilbur Gregory/District Engineer,Corp of Eng.
ASCC
Ken Calhoon
Resources/W. Hughes

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GREATER SITKA

Chamber of Commerce, Inc.

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June 4, 1987

Mr. Win Green, Forest Supervisor
U. S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green,

The Greater Sitka Chamber of Commerce is writing to give our comments concerning reissue of the Draft Environmental Impact Statement (RDEIS) for U. S. Borax Quartz Hill Project.

Our Board of Directors and membership was recently given an overview of this project by a U. S. Borax spokesman. Many questions were answered as to the impact of this venture.

The environmental concerns appear to be minimal for the entire project and have been more than adequately addressed by U. S. Borax. Instead, the issue needs to be the positive impact it will present for the entire state of Alaska.

Our state must diversify from its dependence on oil and develop its mineral resources. The Quartz Hill Project must be given every opportunity for development taking into consideration the environmental concerns which, again, we feel have been met.

The economic feasibility must be considered from U. S. Borax's standpoint. With the two alternatives presented and the small difference between them concerning environmental impact, the obvious choice is the Wilson Arm alternative, since there is tremendous savings to U. S. Borax.

In summary, the Sitka Chamber of Commerce totally supports the Wilson Arm alternative for tailings disposal for the Quartz Hill Project.

Thank you for allowing us the opportunity to comment on this very important project to Alaska's economy.

Sincerely,

Roger L. Hames

Roger L. Hames
President

RLH:mwh
cc list attached

POST OFFICE BOX 638 • SITKA, ALASKA 99835
(907) 747-8604

Q-97

124

GREATER SITKA

Chamber of Commerce, Inc.

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Colonel Wilbur Gregory
District Engineer
U.S. Army Corps of Engineers
PO Box 898
Anchorage, AK 99506-0898

Mr. Bob Grogan
Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Alaska State Chamber of Commerce
310 Second St.
Juneau, AK 99801

Don Finney
Manager
U.S. Borax & Chemical Company
Box 5320
Ketchikan, AK 99901

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(907) 747-8604

125

GREATER JUNEAU Chamber of Commerce
P.O. Box 1227 (907) 586-6420 Juneau, Alaska 99802

June 8, 1987

Mr. Win Green, Forest Supervisor
Forest Service - United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

RE: U.S. Borax Quartz Hill Project

Dear Mr. Green:

On behalf of our organizations membership, I am writing in support of the U.S. Forest Services recommendation that tailings disposal be allowed in Wilson Arm/Smeaton Bay.

The Quartz Hill Project will not only benefit the Ketchikan area but will have a positive effect on the economy of the entire state.

The additional costs of unnecessarily stringent tailings disposal requirements delutes the viability of this project to the extent that it may well not be economically feasible.

Our Chamber of Commerce supports enviromental control and believes the U.S. Forest Service recommendations meet the test of responsible enviromental requirements.

Following these requirements will result in an acceptable balance between a healthy economy and environmental responsibility.

We appreciate the oppurtunity to show our support for this project.

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KETCHIKAN AREA
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Sincerely,

Frank Seiersen
President

C-98

126

8 JUNE 87

W F POWERS
BOX 15
POINT BAKER AK 99927

Win Green
USFS Federal Bldg.
Ketchikan AK 99901

Dear Win; I am writting about this US Borax mess AKA. 071-040-2-840015 waterway Smeaton Bay 5

I thought it was agreed that US Borax would use Boca De Quadra for dumping.

Now because they can save money they want to harm or ruin the Blossom and Wilson river salmon stocks. Are there no other people that have importance, beyond themselves.

I strongly protest this changing the dump site to environmently important areas such as the Rivers.

It seems that when a corporation gets a foothold no matter how covered with good promises it is, they soon drop all pretense and do, or try to do, as they please, considering only themselves. They cry foul if held to original promises. It has to stop

Their product isn't in short supply or rare so there is no vital national necessity for it.

Sure it provides jobs They will import a lot of workers even hiring some local help but while the mineral belongs to all Americans there is no need to destroy or effect harmfully the

livilyhood of local people; many of whom have spent their entire lives here living off of the natural resources in a reasonable manner

We dont need US Borax in the first place so I say comply with sound environmental practice or stay out.

I am sadly reminded of this "promise anything to get in, then do as you please" thing every time I look at our hills. We received many promises before KPC got started in our area, then they were soon forgotten.

I was the fool that convinced the surveyers for a camp site to look at Lab bay again because it could be used, after it was considered inferior to Red Bay or even Buster Bay.

Now I cant even set a crab pot in upper Port Protection without it being stolen My boats get slammed against my float by speeding drunken or dope wasted loggers.

My lifestyle has been sadly effected by broken promises. I dont want to see this happen again so make US Borax comply with sensible environmental practices leaving our rivers untouched,

Sincerely

Warren F Powers

Box 150

Point Baker AK 99927

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Q-99

Homer Chamber of Commerce

June 8, 1987

Mr. Win Green, Forest Supervisor
Forect Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The Homer Chamber of Commerce wishes to voice its support to your choice of the Wilson Arm location over Boca De Quadra in regard to the U.S. Boarx Quartz Hill Project.

After researching the Draft Environmental Impact Statement for this project, we find that the Wilson Arm alternative best meets requirements for protection of fisheries and environmental requirements.

This project should prove to be a valuable to the Alaskan economy, especially now in these times of dwindling oil revenues. We believe all Alaskans should support the development of the Quartz Hill Project so that it can become a viable contender in the world's molybdenum market.

Thank you for giving the Homer Chamber of Commerce this opportunity to lend its support to the Wilson Arm alternative location for the U.S. Boarx Quartz Hill Project.

Sincerely,

Angie Newby

Angie Newby, President
Homer Chamber of Commerce

/ps

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Post Office Box 541 • Homer, Alaska 99603 • (907) 235-7

128

June 6, 1987

F. J. Novak
4301 Rocky Point Rd.
Anaheim, CA 92807

Mr. Win Green
Forest Supervisor, Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Ref.: Quartz Hill Molybdenum Project

Dear Mr. Green:

I wish to oppose the use of the Boca de Quadra fjord as a waste disposal area because

1) the tunnel portal would unnecessarily disfigure a pristine fjord vista;
2) it would significantly lessen the security of employment for at least 1,000 people to be employed at the project.

In addition, I favor allowing a supplemental water supply from the Wilson or Blossom Rivers to further strengthen the security of employment for those 1,000 people and the quality of life for their dependents.

Very truly yours,

F. J. Novak

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RE. Win Green

6-12-87

Dear Sir,

The world does not need molybdenum and The great natural treasure, Misty Fjords does not deserve pollution. Please do not sell out all American's who may yet visit this wonder.

Sincerely,

William Thompson
Ketchikan, AK 99901
P.O. BOX 3231

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Kenai Chamber of Commerce
Box 497
Kenai, Alaska 99611
(907) 283-7989

KCC

June 12, 1987

Mr. Win Green, Forest Superviaor
U. S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

On behalf of the Kenai Chamber of Commerce, we wish to expresa our support for the re-issue of the Draft Environmental Impact Statement for the U. S. Borax Quartz Hill project and the aelection of Wilson Arm as the preferred alternative.

Alaska needs to develop its mineral reaourcea to supplement and diversify its total dependence on oil and with protection for the environment, the Quartz Hill Project ahould be given the best poasible economic opportunity for development.

Thank you for your attention to our concern.

Sincerely,

James E. Carter, Sr.

James E. Carter, Sr.
Preaident

JEC:sc

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June 14, 1987
Rt. 1, Box 903
Ketchian, AK 99901

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Bldg
Ketchikan, AK 99901

Re: Propšsed Moly Mine

Dear Sir:

We strongly feel that U.S. Borax should be allowed to contruct their mill and mine and operate it for the benefit of all people in the Ketchian, area. It is most refreshing, when ourcountry is exporting so many jobs to foreign nations, that a company as large as U.S. Borax is willing to invest their money and expertise to employ our people. At least the moly is on U.S. soil and our country won't have to import this mineral.

Our people need jobs and our area is in critical lneed of a more healthy economy.

Sincerely,

D.J. McDonald

D.J. McDonald

Mary H. McDonald

Mary H. Mcdonald

cc: Mr. Robert S Burd
Director, Water Div.
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, WA 98101

Col. Wilbur Gregory
District Engineer
U.S. Corps of Engineers
P.O. Box 898
Anchorage, AK 9950600898

Mr. Bob Grogan, Director
Div. of Govermental Coordination
Pouch AM, Juneau, AK 99811

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Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept of Agriculture
Federal Blding
Ketchikan

Mr Green - I feel that U.S. Borax has played Ketchikan for a sucker for years and I worry that they will destroy the local environment as they cut all corners to plunder Quartz Hill. I too believe that environmental controls should be "reasonable" but fear that U.S. Borax would kill every salmon in Southeast Alaska if that would save them money.

This is one case where I fully support the efforts of the local environmentalists to keep corporate greed under control.

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Sincerely

Lonnie L. Haughton
P.O. Box 3006
Ketchikan, AK 99901

133

June 5, 1987

U. S. Department of Agriculture
Forest Service
Region 10
Tongass National Forest
Ketchikan Area
Federal Building
Ketchikan, AK 99901

Subject: NPACO No. 071-OYD-2-840015, Smeaton Bay 5, U. S. Borax on behalf of Pacific Coast Molybdenum Company, Quartz Hill.

Gentlemen:

As a private citizen, I feel that their is a definate need to permit the Quartz Hill Project so that both the economic competitiveness of the project and environment receive equal protection. With all of the time and effort put into this project already, it would be a shame if it was not allowed to be brought to completion so that the people of Alaska and the United States could not benefit from such a rich source of basic raw material (molybdenum).

Also, it appears to me that the only logical place for the tailings disposal is in Wilson Arm/Smeaton Bay.

Sincerely,

David G. Austin
P. O. Box 3276
Thousand Oaks, CA. 91359

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Seward Chamber of Commerce
P. O. BOX 749 • SEWARD, ALASKA 99664
PHONE: (907) 224-3046
224-8051

June 12, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The Seward Chamber of Commerce would like to extend its support of Wilson Arm as the preferred alternative for the U.S. Borax Quartz Hill Project.

Upon review of the Draft Environmental Impact Statement, the Chamber Board is in agreement with your choice of Wilson Arm for placement of the tailings.

It has become apparent that the State of Alaska must develop its mineral resources to diversify its total dependence on oil. With taking protection for the environment into high consideration, the Quartz Hill Project should be give an economic opportunity for development.

Thank you for permitting us to comment on this matter.

Sincerely,

Cathy M Clark

Cathy M. Clark
Manager

CMC/ch

cc: R. Burd
W. Gregory
B. Grogan

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SOUTHEAST STEVEDORING CORPORATION
CONTRACTING STEVEDORES
P.O. BOX 8080
KETCHIKAN, ALASKA 99901

Cable Address "Sousteve"
Telephone 225-6157
Telex: 099-55-295

June 15, 1987

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Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Bldg.
Ketchikan, Ak. 99901

Dear Win:

Economic Development seems to be the current focus of much effort, meetings etc. to hopefully find some solution to our employment problems.

Sometimes Economic Development seems to be some unknown element that is out there, but we just can't seem to put our hands on it or reach it or find a solution for it to work. There are many many ideas, suggestions, hopes, wishes and plans - as an example the S.E. Economic Symposium that I recently attended in Juneau.

The U.S. Borax Mine is a tangable Economic Development project - it is something we can see, feel, and can be a reality.

There seems to be opposition to any kind of progress by some - no matter what the environmental protections provide. I am sure the majority of us ie. the residents of Alaska feel we want and need a solid economic future. I have operated a business in Alaska for over 35 years, I have been envolved in politics, land battles, Chamber of Commerces, Sports Organizations etc. I know of very few individuals who, in their hearts, are not basically environmental minded - not rabid, but want to look to the future of our great State, but some issues can be carried too far by too few vocal individuals or organizations (whose memberships sound great in numbers until we realize they are counting the same names over and over), who would stop progress in any name.

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Page 2 - Win Green

Fish can be caught, timber harvested, minerals mined with proper guidelines to limit the environmental impacts - heaven, there are enough agencies looking after this, but the thing we must keep in mind is the people (workers, families, children). Private economic development is what made this country so great - we must continue to support this.

I urge you to do everything possible to assist the U.S. Borax Co. in developing their Quartz Hill properties in the least expensive way possible in order that they can be competitive and to help them get on line as soon as possible in order to allow them to create jobs and employment opportunity for our people.

The use of Wilson Arm - Smeaton Bay disposal sight will go a long way in getting this project underway. I urge that you select this alternative. Also please do what you can to assist U.S. Borax in securing a low cost source of water and power. It might be helping U.S. Borax now, but in the longrun it will help all of us in the form of jobs, security, diversification of our economy - which we desperately need.

Yours very truly,

SOUTHEAST STEVEDORING CORP.

Cliff R. Taro

Cliff R. Taro, President

cc: Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, Wash. 98101

Colonel Wilbur Gregory
District Engineer
U.S. Army, Corps of Engineers
P.O. Box 898
Anchorage, Ak 99506-0898

Mr. Bob Grogan, Director
Office of the Governor
Division of Government Coordination
Pouch A
Juneau, Ak. 99811

Steve Cowper, Governor
State of Alaska
120 4th St.
Juneau, Ak. 99811

136

JOHN R. SWANSON
P. O. Box 6554
Minneapolis, Minn. 55406

June 11, 1987.

Tongass National Forest
Ketchikan Area
Federal Building
Ketchikan, Alaska 99901

Dear Sirs;

Please accept my Comments, as follows, concerning
Quartz Hill Molybdenum Project Mine Development - Revised Draft Environmental Impact Statement.

I wish to advise of my firm opposition to the proposed Quartz Hill Molybdenum Project Mine Development, and to be located in the Misty Fiords National Monument: Tongass National Forest, Alaska.

For this project, even on a modified level, will decimate the Quartz Hill - non-Wilderness Area's water, soil, air, wildlife, fish, botanic and roadless resources, thus, actually destroying this Quartz Hill area and inviolance. With the clear understanding that this entire non-Wilderness area contains natural features, that are unique, vivid and always very fragile. And as this entire Quartz Hill non-Wilderness area will be to serve man, on half-site, as a natural primeval area, I, thus, urge that this non-Wilderness area of some 152,000 acres be now dedicated as a Wilderness, and now added to the current Misty Fiords Wilderness, as a total of some 2,295,000 acres.

As well as to expand this Wilderness to include valuable wilderness - type areas, so as to enlarge this Wilderness, for the Misty Fiords Wilderness, of 3,185,000 acres.

For when we save Wilderness; we save Alaska and America!

Sincerely,

John R. Swanson.

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David Wieler
Box 611
Ward Cove, AK 99908
6-11-87

US. Forest Service
Federal Bldg.
Ketchikan

re: Borax R.D.E.I.S.

Sirs:

#1

This letter is in support of the Boca de Quadra Tail'ngs Disposal. It seems unlikely that the mine will come to operation without it being in operation for a long time, therefore the best disposal of tailings should involve the site with the greatest capacity and the least environmental damage. The Wilson-Blossom Rivers are very major fish producers with even greater potential than is naturally utilized. The Wilson was proposed as one of the few natural upwelling freshwater spawning areas, and having potential for spawning channels 20 years ago. (Chet Matson - Wrangell aquaculture conference). In addition, Mr. Randall of U.S.Borax in his initial visit to Ketchikan said that he thought that 7 barrels a day of diesel oil would be lost ~~daily~~ in the recovery of moly. That is signifigant pollution. The pollution caused by polymerised precipitated globules of tailings sunk to the bottom of the bay is insignifigant compared to the effects of the diesel, until the level of the conglomerated tailings reaches a certain level. According to the studies this level is 100 meters and will be reached before the end of the life of the deposit. Therefore the tailings should be dumped in the deeper fjord, even if it costs a lot more at the beginning.

#2

The townsite should be selected in the best possible location. Space, sunshine, and waste disposal shou'd be given consideration. It is possible that this townsite will become one of the largest cities in SE Alaska. If rail linkage was made possible to Prince Rupert, possibly along a hydropower right of way, the city would Blossom.

Respectfully,

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DRS. WILSON AND SALNESS, P.C.
ARTHUR N. WILSON, M.D., 1898-1983
JAMES A. WILSON, M.D., F.A.C.S.
ARTHUR N. WILSON, JR., M.D.
TY A. SALNESS, M.D.
P.O. BOX 8678
KETCHIKAN, ALASKA 99901

June 17, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

This letter is in regard to the request for public comment regarding the development of the U.S. Borax Quartz Hill molybdenum project.

I am writing as a twenty five year resident of Ketchikan, who is as seriously concerned about our environment, as I am our area's economic health. I have also kept informed on the surveys, research, impact statements, etc., which have been released by all parties interested in the development of the Quartz Hill area.

At this time I feel strongly that U.S. Borax should be allowed to proceed with their Quartz Hill development without further delays. I believe Borax has developed their plans carefully, with great concern for environmental impact, and I think their rationale for tailings disposal in Wilson Arm is reasonable and environmentally sound.

I feel that the Quartz Hill development is essential to the future economic stability of Ketchikan and should be started as soon as it is economically feasible.

Sincerely,

Sharon R. Wilson

Sharon R. Wilson

SRW/mc

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P.O. Box 178
Coffman Cove, Alaska 99950
June 17, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Win:

We are in support of the Quartz Hill Molybdenum project. Borax should be allowed to go ahead with tailing disposal in Wilson Arm. U.S. Borax has gone through all the time and efforts to take care of the surrounding enviornment.

Ketchikan,Alaska and the State of Alaska need the responsible use of thier resources to provide employment. As a family dependent on the timber industry and the use of another of the resources of our Country, we realize that our livihood depends on how our comments are taken.

You have to consider our future and our childrens also. We have to consider the economies of the towns, the needs of families to earn a living in the areas we choose to live in. You have to consider the people who want to work hard and pay the taxes to keep our Country going. There is no reason the timber industry, the fishing industry, the tourism industry and the mining industry can not live in harmony with each other. It will take careful planning and compromise but we can have the beauty and solitude of the wilderness areas and the jobs in the multiple use areas to support them (Wilderness Areas). Towns need people, people need jobs, the United States need both.

We hope you will consider all of this when you make your decision, so then the time and market is right, U.S. Borax can go ahead and get to work.

Sincerely,
Bob and Pat Rowland

Bob + Pat Rowland

cc. to:
Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

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copies to: Gov. Cowper
Robert Burd
Col Wilbur Gregory

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Petersburg, AK
June, 18, 1987
Jim Green
Box 1154
Petersburg, AK 99833

Mr. Johnson

I understand that the deadline for comment on the U.S. Borax mine, in the Misty Fiords area, is June 30. I've already written you once and would like to thank your Department for sending me a copy of the environmental impactstudy.

I'm a S.E. purse seiner and herring gill netter so I rely fairly heavily on this region for a good part of my income. I enjoy fishing and hope that my son will be able to fish if he desires. I supported the USFS project on Anan Creek. That was an enhancement project that seems to have backfired so I can't support something that has the potential to destroy an area that produces so well. I believe that over the years nature has let these systems evolve into what they are today and with good management (which we have today with the ADFG + USFS) can maintain a sustained yeild which we've experienced the last few years. Renewable resourses should have priority.

I oppose anything that would change the water supply of the Wilson or Blossum Rivers or the dumping of tailings into them. status quo seems to be unpopular but it doesn't seem to impact people the way this project will

Thank you for the opportunity to comment.

Jim Green
Jim Green

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June 18, 87

Dear Mr Ed Johnston,

I am writing to you as a citizen concerned with the environmental impact that U.S. Borax may have if they are allowed to dump mining tailings in the Wilson Arm. This activity would have a long term devastating effect on the ecology of that area.

Also any impediment to marine mobility such as their idea to damn the Blossom River should be nixed.

All environmental considerations should be given highest priority in this project. The long term economics of ecological degradation will be with our progeny and we must make every effort to insure the future stability of this fragile earth.

Thank you for your time.

Sincerely,

Curtis L. Terrell

Mr. & Mrs. Curt Terrell
2358 Engineers Cutoff
Juneau, AK 99801

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June 17, 1987

Mr. Win Green
Forest Supervisor, Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

The U. S. Borax Quartz Hill Project is of vital importance to America and the State of Alaska.

It is necessary to keep production cost effective which dictates that environmental controls must be reasonable and not prohibitive.

I Support U. S. Borax's position of the tailings disposal site, namely, Wilson Arm/Sweaton Bay.

Sincerely,

Daniel P. Walters

Daniel P. Walters
1050 Goldmine Trail
Fairbanks, Alaska 99712

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Dear Mr. Ed Johnson,

I oppose the dumping of tailings by U.S. Borax near the Misty Fjords National Monument because this is dangerous to a healthy fish rearing system...

Do not allow tailings to be dumped in Wilson Arm. If they must be dumped, have them put in the midde basin of Boca de Quadra. Better yet, find a land based dump-site for the tailings.

Do not allow construction of a weir/low dam system that would disrupt fish movement. Do not drain water from the Blossom River for this project.

I oppose the U.S. Borax project in its entirety. If you allow it to happen, have them dump the tailings on a land

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based site. This is public land with a healthy fishery. We owe nothing to U.S. Borax. If they are allowed to mine, it must not ruin the fishery or the environment.

Please keep me updated on this project.

Thank you.

Katya Kirsch
Box 521
Haines, AK 99827

Copies:
Gov. Cowper
Robert Burd
Wilbur Gregory

144

Ed Johnson
U.S. Forest Service
Federal building
Ketchikan, Alaska 99901

17 June 1987

Dear Mr. Johnson

I am writing in concern over U.S. Boraxs' plan to dump tailings from their mine into Wilson arm. I strongly oppose this idea. The fisheries resources of the Wilson, Blossom + Keta rivers are much to valuable of a resource to be put in jeopardy. I could support the EPA's position of putting the tailings in the middle basin of Boca de Quadra. I thought the US. Forest Services' job was to manage for multiple use and to protect recreational and fish + wildlife resources + habitat on public lands for the publice, not for private intrests. All public concerns should be respected before a foreign Corporation profits from public land. Every effort should be made to reduce the mining impacts in Misty Fjords Nat'l Mon. It may cost U.S. Borax a few more dollars, but it sure beats destroying a major Salmon producing area. Remember, fishing is a renewable resource, mining isnt. The loss of those fish would be incalculable.

Thank you for your time + consideration.

Sincerely,
Kurt Kondzela
Kurt Kondzela
P.O. Box 210931
Auke Bay, Alaska
99821

cc. Governor Steve Cowper
Robert Burd - EPA
Col. Wilbur Gregory
Corps of Engineers.

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16400 Virgo Ave.
Anchorage, AK 99516
June 15, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I wish to encourage the Forest Service and the EPA to approve the most cost effective alternatives for the Quartz Hill EIS which will comply with the law. ANILCA requires that you include provisions to "prevent significant adverse environmental impacts". The EPA regulations which are "designed to prevent unreasonable degradation of the marine environment" must also be met.

I submit to you that the disposal of tailings in Wilson Arm and the use of water wells as a safeguard against possible periods of decreased surface water runoff meet both of these objectives. The RDEIS goes into great detail in addressing every possible aspect and nowhere do I see "significant adverse impacts" or "unreasonable degradation" occuring or even being suggested.

This mine must be competitive in the international minerals market. It must compete with mines in countries that repuire little or no environmental safeguards and therefore have a signigicant economic advantage. Quartz Hill must abide by the law, but unnecessary, overly restrictive, and "worst case" situtations must not be imposed if the mine is to have any chance of being profitable to its owners and provide stable employment for its workforce.

After all these years of study it is now time to make a clear decision which will meet the combined environmental and sound business objectives. The RDEIS shows that this can be done.

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Sincerely,

Steven C. Borell

Steven C. Borell, P.E.

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University of Idaho
College of Mines
and Earth Resources
Department of Metallurgical
and Mining Engineering
Moscow, Idaho 83843
(208) 885-6376

June 17, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

We share your concern for proper environmental control. However, we also recognize another environment that most people would consider primary and that is our personal welfare relating to hunger, jobs and a place to live. In other words, personal economics.

Alaska, as you know, is in need of adequate support of its citizens, but Alaskan citizens' welfare also impacts those of us in the lower 48 states. Without jobs or an adequate income, it is important for us as fellow citizens of the United States to see that citizens of Alaska are also adequately taken care of. We would like you to be able to do it on your own through proper industry and income activities.

For more than 40 years I have been concerned about the different problems of the mining industry. I am an avid outdoors man and like to be able to go into the forest or public lands and enjoy them in their near pristine environment. I can't do this without employment of an adequate nature above bare subsistence. This means jobs.

U. S. Borax has proven itself to be a very responsible citizen where ever they have operated a mining property. They attempt to provide a proper balance between jobs and income for the area as well as protect the environment from unnecessary degradation. I have full confidence in their management attitude that they will not do something that they would believe would be unduly harmful to the environment. No activity, even walking in the forest, as you are aware, leaves the forest exactly the way it was. The same goes for the disposal of material in the fiords.

Nature itself is disgorging material into the fiords gradually over a period of millions of years. They will change, no matter what you do. As I understand it, considerable work has been done by EPA and others to determine whether the Wilson Arm or Boca de Quadra is preferable. Also, to my understanding, the end result of one over the other is not going to be of major consequence. There will be a slight difference and none of us can project exactly what this difference will be until it actually happens and is completed.

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I understand that we will be able to measure the economic difference, however, between the two. Right now the market for molybdenum is touchy. Those companies presently producing are finding it a bit of a balancing act, but will be on a downward trend. U. S. Borax going into this operation, will hit this downward trend to be able to continue the U. S. position in the sale of molybdenum. It will continue to be a matter of the economics on the international market for this operation to be substantially profitable. If it isn't profitable, it will be shut down. I would like to see all concerned, yourself included, recognize that the economic position should be made as secure as possible.

The extra capital costs of getting the tailing disposed in Boca de Quadra and the yearly operating costs, rather than in the Wilson Arm, will be detrimental and not offset by the benefit to the environment. These cost savings, by using the Wilson Arm will reflect in your economy and the strength of the company. I believe it is to your benefit and no additional detriment to the environment that the Wilson Arm be accepted as the depository for these tailings.

You may wish to look at a similar situation in the reserve mining iron ore tailings that went into Lake Superior, with little or no harm, but was moved due to strictly political and pressure groups to a surface position at an unacceptable financial cost to the company, and a detrimental environmental end result.

In watching the many cases of pristine environment versus mining or forestry activities, I have been impressed by the number of people who are paid from a tax supported payroll who believe unlimited environmental control is the way to go. Few are impressed by economics because they are not intimately and directly involved by pay check. When one's stomach is threatened, it becomes a different story and we recognize that some compromise between pristine environment and a job is necessary. I have lived in Alaska for five years in the past and enjoyed it and loved it. Back in the 1950's I was concerned about the indiscriminate developmental activities that were degrading the area. Most of these, however, I noticed were around habitations, cities, towns, roads as well as the mining activities, particularly placer. In a recent visit I was happy to see very needed changes, but I was also very concerned about the many attempts to close out the mineral industry of Alaska, which was so supportive of the non-tax supported individuals.

In closing I urge you to follow the best economic course of allowing the tailings to go into the Wilson Arm.

Sincerely,

J. R. Hoskins

J. R. Hoskins
Head, Department of Metallurgical
and Mining Engineering

JH/ec

cc: Robert S. Burd
Colonel William Gregory
Robert Grogan
C. A. Hesse

147

Steve W. Denton
Box 9342
Ketchikan, AK 99901

June 18, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Re: DEIS for Quartz Hill Project

Dear Mr. Green;

This letter is written to express support for the Quartz Hill Project and to urge that the preferred alternative in the final EIS give equal consideration to the environmental, technical, and economic aspects of the project.

The vast amount of effort expanded to study the environmental and technical aspects of the project ensures that the environmental aspects are adequately addressed. Specifically, the plan to dispose of tailings in Wilson Arm/Smeaton Bay has been shown to be environmentally acceptable and should be approved. The technology of deep water tailings disposal has been proven at existing facilities and there is every reason to accept the conclusion that Wilson Arm/Smeaton Bay tailings disposal can be done with negligible environmental degradation. Since the technical and environmental issues have been balanced, the decision on the preferred alternative should weigh the economic consequences heavily. The Wilson Arm/Smeaton Bay alternative is clearly the only reasonable economic choice.

I am a mining engineer by training and an Alaskan by birth and I see both ways of life jeopardized by the regulatory paralysis which has resulted in no significant new economic developments since Prudhoe Bay. You have performed your responsibility to protect environmental values well in the Quartz Hill Project DEIS conclusions; I urge you likewise to give a high level of consideration to the economic consequences of the final preferred alternative.

Sincerely;

Steve W. Denton

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SWD:hd

cc: Mr. Robert S. Burd
U.S. Environmental Protection Agency

cc: Mr. Bob Grogan
Division of Governmental Coordination

cc: Col. Wilbur Gregory
U.S. Army Corps of Engineers

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HARMSWORTH ASSOCIATES

June 18, 1987

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U.S. Department of Agriculture
Forest Service Region 10
Tongass National Forest
Ketchikan Area
Federal Building
Ketchikan, AK 99901
Attn: Forest Supervisor

Subject: Quartz Hill DEIS

Dear Sir:

Having previously supplied the U.S. Borax and Chemical Corporation with environmental services at Quartz Hill I was very interested in reviewing the DEIS.

In my review I was particularly struck by the summary and the EPA's rationale for the Wilson Arm alternative for tailings disposal. There appears to be a concern that fish populations in the Wilson Arm would be more adversely affected than those in Boca de Quadra by "acute toxic levels of copper in the water column" (Summary, p XVI). The EPA has apparently used their "Best Professional Judgement Report" (Appendix S) and the DEIS to support the view. The EPA's letter of comment expressed a number of concerns but it was not clear that acute copper toxicity was a major concern.

#1 The discharge from the mill will consist of tailings in a slurry with seawater and discharged at 150-foot depth. The concentration of dissolved copper in the discharge is dependent upon the amount of seawater used to slurry the tailings. The copper concentration in a mixing zone can, therefore, be readily adjusted to meet required effluent limitations. It is not clear from the DEIS which dilution is proposed for the project, yet this is a key consideration and should be resolved before the mixing zone concentration can be identified.

#2 Table 4-8 shows a worst case concentration of dissolved copper of 11.87 ug/l. However, the method of analysis was to acidify the tailings effluent. The experimental method of acidification prior to testing for dissolved copper may be appropriate for toxicity or bioaccumulation but not to determine the potential in the receiving waters. The acidification may greatly increase the amount of dissolved copper and the 11.87 ug/l figure may be unrealistically

Environmental Consultants
23232 Peralta Drive, Suite 208-211 Laguna Hills, CA 92653 (714) 855-0222

U.S. Department of Agriculture
Katchikan, AK
June 18, 1987
page two

high. The EPA's Best Professional Judgement Report, Appendix S states that "the EPA criteria for metals (50FR30784) are based on 'acid-soluble' assay....This procedure is useful for some applications but is not representative of the dissolved metal concentrations expected in marine waters."

#2 cont.

Moreover, the 11.87 · ug/l figure uses the proposed dilution of only 1:1 by weight whereas it is clear from the DEIS that other dilutions were considered that would greatly reduce the concentration. For example, a 5:1 dilution by weight would reduce the 11:87 ug/l figure to 2.3 ug/l which is below the EPA criterion for copper of 2.9 ug/l. In addition, data from Table 2-3 in the EPA's Best Professional Judgement Report, Appendix S (p 15) show that the liquid phase composition of the mill tailings from bench scale and pilot plant tests were 5.6 and 4 ug/l, respectively. These bench and pilot scale tests are probably more realistic and would decline substantially with proposed dilution.

#3

Appendix S notes that "acute toxicity of discharged tailings is expected to be low" which does not support the concern of high metal concentrations noted in the summary. Even bioaccumulation of metals to toxic levels was reportedly not expected in the upper water column (see Page 87, 3rd paragraph). Therefore, additional documentation should be provided on how the conclusions in the summary were obtained.

#4

I would like to ask the following questions:

1) Why is the 11.87 ug/l figure for dissolved copper being used rather than the more realistic 5.6 and 4 ug/l figures obtained from actual bench and pilot plant testing?

2) What dilution would be used during actual plant operations and how would this affect the copper concentration?

#3 cont.

3) What would the dissolved copper concentrations be if tests were run without acidification?

#2 cont.

4) How many fish will suffer from acute copper toxicity under actual proposed conditions in both Wilson Arm and Boca de Quedra and how does this outweigh the other significant terrestrial impacts of using Boca de Quadra?

#5

U.S. Department of Agriculture
Ketchikan, AK
June 18, 1987
page three

#6

5) Is there any evidence to suggest significant levels of acute copper toxicity on the fish outside of the mixing zones at Island Copper and Kitsault, and, if so, what were the dissolved copper concentrations?

#7

6) Why is the potential effect of acute copper toxicity on fish populations of concern even at 11.78 ug/l, when there is data to show that acute toxicity does not occur until much higher levels, e.g.

Chinook salmon 178 ug/l
Chinook salmon at hatch 31 ug/l
Chinook salmon 1 month 18 ug/l
Brook trout 100 ug/l
Silver salmon 450 ug/l
Data from: Water Quality Criteria for Water, EPA 1976.

#8

7) If acute copper toxicity is of major concern in the selection of two alternatives why hasn't the published acute toxicity data for the commercial and sports fish of concern been analyzed in the EIS and an estimate of fish mortality developed?

#9

It is important to note that while regulatory standards must be met they are usually conservative standards and do not necessarily reflect the concentration levels at which acute toxicity will occur.

#10

U.S. Borax and Chemical Corporation should be required to provide sufficient dilution of the tailings effluent to avoid acute copper toxicity of commercially and recreationally import fish species outside of a mixing zone. This will have the effect of avoiding any potential for acute copper toxicity and thus make the use of Boca de Quadra unnecessary thereby avoiding significant terrestrial impacts in a wilderness area.

Of the two alternatives for tailings disposal, Wilson Arm should be the preferred alternative.

Yours sincerely,

Rodney V. Harmsworth

Rodney V. Harmsworth
President

RVH/jr

P.O. BOX A-8
WARD COVE, ALASKA 99928
907-247-2228

COASTAL MACHINERY INC.

5295 GLACIER HWY.
JUNEAU, ALASKA 99801
907-780-4030

June 18, 198[illegible]

Mr. Win Green
Forest Supervisor
Federal Building
Ketchikan, Alaska 99901

Mr. Green:

I am writing this letter in support of the U.S. Borax Quartz Hill project. Since I do not have a scientific background and since I am neither a fisherman nor do I have any mining background, I cannot offer arguments based on these experiences. I can, however, argue that since I do live and work in Ketchikan, Southeast Alaska, the dominoe effect of starting up and continuing such a project will affect almost all businesses and working people throughout Southeast Alaska.

Because of the ups and downs of the major industries in Southeast Alaska such as logging, fishing, and tourism, a project of this magnitude would certainly provide a secure year-round basis for employment and stability.

I have travelled throughout the world (mostly with the military service) and have lived in several places in the United States. Because of this travelling experience I have come to realize that the people of Southeast Alaska, especially my good friends and neighbors in the Ketchikan area, are a hard working, down to earth people who will earnestly support this project. We need this project just as any town needs a basic industry or industries to survive.

I appreciate the opportunity to express my views on this project.

USDA—FOREST SERVICE
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Sincerely,

Donald K. Pierce

Donald K. Pierce
P.O. Box 1216
Ward Cove, AK. 99928

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Charles T. Angelis
412 Crescent Way
Anaheim, CA
92801

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK
99901

Dear Mr. Green:

I am writing this letter in response to the Revised Draft Environmental Impact Statement "Quartz Hill Molybdenum Project Mine Development". After carefully reviewing the EIS I found myself questioning the reasoning behind EPA's the selection of Boca de Quadra fjord over Wilson Arm fjord for disposal of mine tailings. In view of the significant added cost of tailings disposal in Boca de Quadra fjord I feel that this is an unwarranted restriction.

#1

Economically this project would benefit the local economy and improve the position of the United States in the World market. Molybdenum is a rare, costly element whose compounds are used in high grade steels and lubricants. Unfortunately the increased cost imposed by unnecessarily expensive tailings disposal would be passed on to the consumer eroding the competitiveness of this project.

#2

In summary I believe that this project should be allowed to proceed. There is minimal impact on the environment and good economic benefits.

Yours Truly,

Charles T. Angelis

Charles T. Angelis

Copies To: Mr. Robert S. Burd, EPA
Colonel Wilbur Gregory, U.S. Army, Corps of Engineers
Mr. Bob Grogan, Office of Governor of Alaska

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91 West End Avenue
Shrewsbury, NJ 07701
June 16, 1987

Mr. Win Green - Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

As a former Biologist for NOAA, I am familiar with Environmental Impact Statements in general and Quartz Hill specifically. Over the years since this project became public, I have noted with interest the great care given by both state and federal agencies during Quartz Hill's development.

It is this concern that requires me to address the mill tailings disposal sites involving Wilson Arm/Smeaton Bay and Boca De Quadra.

Boca De Quadra is in fact deeper than Wilson Arm/Smeaton Bay area. But the increase impacts on terrestrial, visual, noise and marine in the middle basin area could very easily outweigh the advantages of Boca De Quadra's deeper basin. In addition, there is virtually no background information on the significance of the visual and aesthetic effects of the tunnel portal on Boca De Quadra's shoreline. These effects would be seen from the time mill tailings disposal began in Boca De Quadra's area located within the Misty Fiords National Monument Wilderness.

Finally, the economic costs to U.S. Borax could be significant, threatening the economic competitiveness of the project.

#1

In the case of Wilson Arm/Smeaton Bay, the E.P.A.'s Best Professional Judgement Report (Appendix S), points to "the latter year of the projected mine's life" and their concern for accumulation of tailings above the 100 meter depth and its containment. It would appear the E.P.A. presumes that Alaskan mining practices will remain static during the more than 50 years the mine will be in operation and that U.S. Borax will not look for ways to improve mill tailings disposal techniques.

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One way of substantially reducing the risks during these "latter days" is through the method E.P.A. issues the permits. As stated in the RDEIS, permits could be issued prohibiting accumulations above the 100 meters of the water column and from tailings overflowing the down-fjord sill. Also, periodic monitoring of heavy metal contaminants would help to insure that benthic and pelagic habitats in the upper water column would remain diverse, productive, and stabile within the Wilson Arm/Smeaton Bay area.

That is why I ask you to grant tailings disposal permits to U.S. Borax for the Wilson Arm/Smeaton Bay Area that will strike both an environmental and economic balance.

Sincerely,

Thomas Wilhelm

Thomas Wilhelm

TW:jc

cc - Mr. Robert S. Burd
Director, Water Division
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

- Colonel Wilbur Gregory
District Engineer
U.S. Army Corp of Engineers
Box 898
Anchorage, AK 99506-0898

- Mr. Bob Grogan - Director
Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

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Bechtel Environmental, Inc.
Engineers - Constructors

Fifty Beale Street
San Francisco, California
Mail Address PO Box 3965, San Francisco, CA 94119

June 19, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The following comments are submitted in response to the Forest Service's request for comments on the Quartz Hill Molybdenum Project Revised Draft Environmental Impact Statement (RDEIS).

Bechtel and the United States Borax and Chemical Corporation (U.S. Borax) conducted a feasibility evaluation of the Quartz Hill Molybdenum Project from January 1982 through July 1984. During this evaluation Bechtel examined the costs, technical feasibility, and environmental impacts of several alternative development concepts. We also assisted U.S. Borax in formulating a functional plan of development that met established environmental criteria and was lower in cost than other concepts considered.

Based on our knowledge of the project, Bechtel believes that this world-class mineral resource can be developed in a manner that balances economic and environmental values, consistent with national and State of Alaska interests. Bechtel particularly agrees with the Forest Service's preference for tailings disposal in Wilson Arm-Smeaton Bay and disagrees with the EPA's preference for tailings disposal in the Boca de Quadra as presented in Section 2.7 of the RDEIS. Our comments on that issue are outlined below. We support the Forest Service's Preferred Alternative, with the exception of the water supply development scheme. Our views on this issue are also described below.

LOCATION OF TAILINGS DISPOSAL

Bechtel agrees with the Forest Service's preference for marine tailings disposal in the Wilson Arm-Smeaton Bay. We have performed extensive studies on marine disposal in Wilson Arm-Smeaton Bay and Boca de Quadra and agree that:

- with appropriate mitigation, there is little difference in the environmental effects of tailings disposal in the marine environment between the Wilson Arm and Boca de Quadra fjords

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- disposal in Wilson Arm-Smeaton Bay will confine environmental impacts of mine development to a single drainage
- impacts on Wilderness Area values of the Misty Fjords National Monument, characterized by the RDEIS as moderately significant, will be avoided completely by Wilson Arm-Smeaton Bay disposal
- the development and operating cost savings associated with Wilson Arm-Smeaton Bay disposal will result in greater community stability for Ketchikan and Southeast Alaska.

In presenting the EPA's Preferred Alternative, the RDEIS (p. 2-52) summarizes potential environmental impacts of disposal in each of the two fjords. Based on our studies, Bechtel disagrees with the reasons cited by EPA for selection of Boca de Quadra as the preferred tailings disposal location. Our comments on those reasons are as follows:

#1

1. The EPA notes that there is minimal possibility in Boca de Quadra for suspended tailings to reach the upper part of the water column (depth < 100m) and affect fish and shellfish or their food sources. However, modeling of suspended sediment transport by Bechtel and the University of Alaska showed lower concentrations of suspended tailings fines in the near surface waters of Wilson Arm - Smeaton Bay than for Boca de Quadra, particularly in the 50-70m depth range. This was true at all stages of the project life.

   In addition, environmental studies performed by Bechtel and VTN indicated that the limits of biologically significant penetration of sunlight in these waters was on the order of 30m (100ft). Neither the RDEIS nor our studies indicate that sediments will reach this level. Thus, we can find no support for the EPA's conclusion that fish or their food sources will be adversely affected by suspended solids.

#2

2. The EPA notes that the active deposition area for tailings would be below approximately 150m for Boca de Quadra, whereas in Wilson Arm - Smeaton Bay there is a possibility that tailings could accumulate at or above the 100m level in the latter years of the project. This comment requires a twofold response. First, the top of the tailings deposits in Wilson Arm - Smeaton Bay will be below 100m until after year 34 (Figure 3-4, EPA BPJ Report). At this stage, or before, if undesirable effects are observed, the outfall could be moved down the fjord into deeper water, which would limit the top elevation of the tailings. Second, the most active area in terms of slumping of deposits will be near the outfall on the side slopes of the fjord. The proposed depth of both the Boca de Quadra and Wilson Arm - Smeaton Bay outfalls is the same, 50 m.

#3

3. EPA notes that there is little opportunity for the Boca de Quadra discharge to reach, and therefore potentially affect productive estuarine habitat at river mouths. But this is also true for the Wilson Arm - Smeaton Bay discharge due to the steep slopes at the river end of Wilson Arm. There is little difference between the predicted concentrations of suspended sediment at the upstream end of the fjords (compare Figure 4-10 and 4-13 in the EIS.) Indeed the top of the plume is deeper for the Wilson Arm - Smeaton Bay case than for the Boca de Quadra; thus, potential impacts on the estuarine environment may even be less in Wilson Arm - Smeaton Bay than in Boca de Quadra.

Also, if field observations were to show that deposited tailings were affecting the estuarine environment in Wilson Arm - Smeaton Bay, the discharge could be moved down the fjord. In this case, the ridge of deposited tailings at the first location would prevent upstream intrusion of the new tailings.

#4

4. The EPA notes that for Boca de Quadra there is almost certain containment of the tailings in a single basin, whereas in Wilson Arm - Smeaton Bay this is not assured. The Bechtel modeling effort demonstrated that the tailings could be contained within Wilson Arm - Smeaton Bay, based on an assumed density vs. depth (of overburden) relationship for the tailings, and the assumed stable slope of the tailing deposits. These assumptions were based on data from actual tests and field observations. The density vs. depth relationship was obtained from tests performed at the University of British Columbia. The stable slope (0.5 percent) was based on observed deposits for similar discharges. It should also be noted that even if tailings actually deposit at slopes exceeding 0.5 percent, the discharge could be moved down the fjord in later years of operation to ensure containment in the fjord.

#5

5. EPA is concerned that there is less opportunity for dilution of potentially toxic metal concentrations in Wilson Arm - Smeaton Bay, and thus a higher potential for impacts within the upper 100 m of the water column. Based on our analyses, this is not correct. The amount of dilution that occurs in the fjord is governed principally by the supply of flushing water entering the fjord, and the transport of contaminants out of the fjord. As discussed in comment #1 above, our analyses of suspended sediment concentrations indicated that there will be less build-up and hence higher dilutions in Wilson Arm - Smeaton Bay than in Boca de Quadra. This conclusion applies equally to both heavy metal concentrations and to suspended fines which have a very low settling velocity, and act in many ways similar to a passive tracer.

#6

6. EPA notes that disposal in Boca de Quadra will result in terrestrial, visual, noise and marine impacts in the Misty Fjords National Monument and in the Wilderness Area. This disposal scheme would create impacts in two drainages instead of one. EPA proposes to mitigate impacts through agency actions.

#6

Bechtel fails to see the logic in EPA's reasoning. The Wilson Arm-Smeaton Bay disposal scheme would completely avoid impacts on the Wilderness Area; thus, no mitigation would be required. Marine impacts of the two disposal schemes would be essentially the same, while the Wilson Arm-Smeaton Bay scheme would limit impacts to a single drainage and would have significant economic and social advantages.

WATER SUPPLY

During its 2 1/2-year feasibility evaluation of the project, Bechtel examined various water supply sources and combinations of sources to meet project water requirements. One of the alternatives considered was construction of a large dam (more than 100 feet high) at Tunnel Creek to supply the project's entire water requirement during Phase I and II. This scheme with the addition of a Blossom River emergency backup supply, is incorporated into the Forest Service's Preferred Alternative.

#7

Another alternative considered was construction of an approximately 50-foot high dam at Tunnel Creek, which together with a supplementary supply on the Wilson or Blossom River, would satisfy the project's water requirements during both Phase I and Phase II. In this scheme, the dam would be constructed at the beginning of Phase I and the supplementary supply would be installed either initially or at the beginning of Phase II. Bechtel recommended this alternative because it:

1. could reduce the project cost by $30 million to $50 million (1984 dollars)

2. could be inherently more reliable than the Tunnel-Creek-only scheme, and

3. would protect fishery resources in Tunnel Creek and the Blossom River, provided that required instream flow releases are maintained.

Bechtel appreciates the opportunity to comment on the RDEIS.

Very truly yours,

John J. Meersman
Project Environmental Manager

cc: Mr. Robert S. Burd, U.S. EPA
Colonel Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Office of Governor, State of Alaska

JJM:sfj

153

DEAR MR. JOHNSON.

IN THE FIRST PLACE, I DON'T SEE WHY ANY MINING IS BEING ALLOWED IN MISTY FJORDS NATIONAL MONUMENT! I LIVED IN ALASKA FOR 25 YEARS & AM REALLY SICK & TIRED OF THE CONTINUING RESOURCE DEGRADATION.

HOWEVER, IF IT IS TO HAPPEN, I FAVOR USING BOCA DE QUADRO FJORD FOR DUMPING TAILINGS AND TO HECK ~~WITH~~ WITH WHAT U.S. BORAX CORP. WANTS.

Joyce Stevens

20 JUNE 1987

JOYCE STEVENS
BOX 2116
CARMEL, CA.
93921

SALINAS CA 939 2A PM 21 JUN 1987

RECEIVED
KETCHIKAN AREA
JUN 23 1987
TONGASS
KETCHIKAN. AK 99901

EDWARD P. JOHNSON
U.S. FOREST SERVICE
FEDERAL BUILDING
KETCHIKAN, ALASKA 99901

154

Re: Borax Quartz Hill project June 20/87

Mr. Win Green, Forest Supervisor

It is absolutely imperative that this mine start up as soon as possible. For this to happen Borax must have permission to dispose of the tailings in Wilson Arm.

The environmental impact has been found to be basically the same in Wilson Arm as in Boca De Quadra, with little or no adverse impact to fish or any other living thing, but the economical impact to Borax (and thus to Ketchikan) is astronomical. And a decision against Wilson arm would in all probability mean the end of the project, or at the very least delay it for decades.

We need the jobs now. And we need the jobs in the future for our children.

This project simply must get the permits it needs without any more delays.

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KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

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FOI				

Sincerely Robert E Dawson
& Alice M. Dawson

Route 1, Box 2076
Ketchikan, Alaska
99901

To WinGreen
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

155A

NAME R. Pollenhagen
P O Box 56
Pt. Baker, Alaska 99927

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Rodalle Pollenhagen

Other comments,

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KETCHIKAN AREA
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To WinGreen
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

155B

NAME
P O Box
Pt. Baker, Alaska 99927

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Sue Betzina
P.O. Box 26
Point Baker, AK 99927

[redacted]s,

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To WIN GREEN
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

NAME JOAN KAUTZER
P O Box 129
Pt. Baker, Alaska 99927

155 c

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best environmental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Joan Kautzer

Other comments,

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To WIN GREEN
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

NAME JOS. SEBASTIAN
P O Box 129
Pt. Baker, Alaska 99927

155 d

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best environmental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Joseph Sebastian

Other comments,

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To WinGreen
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

NAME Herbert Oyler 155e
P O Box 2
Pt. Baker, Alaska 99927

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Herbert Oyler

Other comments,

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FOREST SUPERVISORS OFFICE

To WinGreen
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

NAME Mike Mortell 155f
P O Box 53
Pt. Baker, Alaska 99927

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Mike Mortell

Other comments,

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KETCHIKAN AREA
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To Win Green
USFS-Federal Bldg.
Ketchikan AK
99927
Due Date 6-30-87

NAME Sonja Paine
P O Box 2
Pt. Baker, Alaska 99927

May 1987

155g

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Sonja L. Paine

Other comments,

Q-121

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156

David L. Nebert
Institute of Marine Science
University of Alaska
Fairbanks, AK 99775-1080

22 June 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I was involved with the tailings disposal portion of the U.S. Borax project between 1978 and 1983. My involvement has included gathering, processing and analyzing the voluminous physical oceanographic data collected on this project. During my association with the project I have made an attempt to remain neutral in the decisions as to whether or not the project should go ahead or where the tailings should be placed.

#1 The circulation of the fjords studied is fairly well stated in the EIS though I enclose some clarification/comments with this letter. The point NOT made by the EIS is that we still do not understand why the fjords circulate as they do. This knowledge could clarify what will eventually happen to the circulation in the inner basin of Boca de Quadra or within Smeaton Bay/Wilson Arm when the bottom depth is reduced by tailings deposition. Further study of existing data may shed light on the forcing behind the observed circulation, and thus the subsequent changes in circulation associated with shoaling due to tailing deposition.

#2 Realistically, with the limitations of real data collection, we will never know all there is to know about the fjord systems. However, with what is now known, it appears that tailing deposition in either fjord will probably not serious degrade surface water quality. We have documented an inflow in the near surface waters that appears to be independent of season. This is a feature which will tend to discourage the upward movement of tailings, even during winter when upper water column stability is weakest. And in summer/fall when bottom water renewal occurs and the deep water stability is weakest, there is a strong pycnocline at 30 to 100 meters which will tend to restrict the tailings to the deeper waters.

#3 I feel that U.S. Borax has provided substantial funding for, and has not restricted in any way, the study of potential problems associated with sea disposal of tailings. I also feel that the results of the study support the contention that minimal degradation of the upper water column will occur no matter which fjord is chosen for tailings deposition.

Sincerely,

David L. Nebert,
Oceanographer, IMS

USDA-FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

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cc: copies to:

Mr. Robert S. Burd
Director, Water Division, Region X
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, Washington 98101

Colonel Wilbur Gregory
District Engineer
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, AK 99506-0898

Mr. Bob Grogan
Director, Office of the Governor
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

156

ATTACHMENT: Comments on the U.S. Borax EIS

by D. Nebert, June 1987

I am confining my clarification/comments to sections 3 and 4 of the Revised Draft, Environmental Impact Statement, and Section 3 of the Comments and Responses to the same document. While other sections and comments may also deserve comments, the voluminous nature of the text preclude me from doing reviewing more of the text.

Revised Draft EIS:

#4

Section 3.1.6, p3-40, second par:

"Renewal, related to the Dixon Entrance upwelling index, does not appear to be an annual event (Nebert 1985, p. 24)."

This interpretation is incorrect. What was said in the referenced text was that "...there is no obvious relationship to known El Niño events. In addition, there is no obvious periodicity to the appearance of below normal upwelling years." In fact, the upwelling index at Dixon Entrance has a very strong annual signal.

#5

p3-41, last line:

"Seasonal dependent upper layer flow in deep water." I don't know what this means.

#6

Section 4.1.6.2, p4-44:

Figure 4-2 has the circulation labeled as hypothetical. I find this confusing, since it shows a circulation that is neither typical of "classic" fjord circulation, nor of that found in the study area fjords.

#7

p4-58, first bullet statement:

Vertical stratification is weakest in the lower water column, but very strong in the uppers waters during the period of deep water renewal; it is very unlikely that tailings would be transported into the near-surface waters during this period.

#8

Second bullet statement, last sentence:

This sentence is not correct since it implies that deep water renewal can occur during winter when water column stability is low. None of the data collected during the study suggest that deep water renewal can occur during winter; the deep waters adjacent to the study fjords are not dense enough to replace deep waters except during summer/fall when upper water column stratification is always strong.

#9

p4-60, 4th par:

The implication is that the inner basin flushing rate will decrease when tailings fill the basin is unjustified since the cause of this circulation is not understood.

#10

Section 4.1.6.3, p4-65, second par:

A strong pycnocline may be considered as a leaky lid, but it should not be considered as impermeable.

#11

Bullet statement at page bottom:

I do not concur that the central basin waters are "...always more stable than the inner basin waters...". This is not true without some sort of qualification.

#12

p4-67, second bullet statement:

The data collected do not suggest it is likely that tailings scoured by deep water renewal could reach the near surface waters; this scouring would occur at times of maximum vertical stratification in the upper water column.

#13

Section 4.1.6.5, p4-72:

The an interpretation of the modeling effort suggests that the fjord circulation (flushing) will weaken as the fjord deep waters fill with tailings. This is certainly one possibility, the others being that it will strengthen or stay the same. I do not feel that the first interpretation is more than a guess because we so not understand what is driving the observed circulation. The fjord model does not predict all of the present circulation features; I cannot put too much faith into predictions of what will happen when tailings have altered the bathymetry.

Comments and Responses to the Revised Draft EIS by EPA:

#14

Section 3, last par of Summary:

"There will be no retention and slow mixing of dense water brought in during summer deepwater renewal. Consequently, density-driven winter currents will not exist, and ..."

It was originally proposed that the "stored" dense water was responsible for the winter, sill depth outflow. However, independent calculations by myself and Herman Bode, as reported in *Marine Tailings Disposal*, D.V. Ellis, editor, on page 307, suggest that the dense water stored within the basin is insufficient by itself by almost an order of magnitude to drive the observed outflow. This supports my contentions above, that we do not yet understand the primary driving mechanism in these fjords. The point to be made is that we cannot predict with certainty what will happen as the fjord basins fill. I suggest that

2 of 3

#14 Cont.

after filling the basin with tailings, the circulation will not drastically differ from what we now observe.

#15

Page 44, last par:

A minor point; summer weather patterns do not generally produce much in the way of upwelling off the coast of British Columbia; it is rather a relaxation of downwelling. It is the relative difference (the change) that is important rather than the sign.

#16

Page 48, third par:

See comment on summary above; it is unlikely that sill-depth outflows will be halted as a result of filling the basin.

#17

Page 50, first par:

The work of Seyer and Smith (Unpublished report to Bechtel Civil and minerals, 1983) suggest that breaking lee waves are not likely in Boca de Quadra.

3 of 3

157

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JUN 24 '87
FOREST SUPERVISORS OFFICE

F M Smith
Mining Consultant
S.R.2 Box 3421-A
Tehachapi Ca 93561

Mr Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan AK 99901

Subject; The Quartz Hill Project

Much of Alaska's economic and social progress depends upon the developement of mineral deposits such as the Quartz Hill molybdenum ore body. With a life of over fifty years, the Quartz Hill project will employ thousands of Alaskans and provide tax revenue to both Ketchikan and the state. Safeguards for the protection of the environment, air, water, fisheries etc have been provided for in this project.I respectfully urge that the final EIS will recommend that the necessary permits be issued for development of this deposit.

I support the Forest Service preferred alternative for tailings disposal in Wilson Arm because it would

1)Eliminate a $59 million capital cost and a $1.6 million annual operating cost.These savings (equivalent to about 55¢ per pound of molybdenum produced) would influence how soon construction could start as well as the ability of the project to be competitive.

2) Lessen the impacts on wilderness values since it would not be necessary to construct tailings disposal areas in the designated Wilderness area as would be required if disposal were in the Boca de Quadra fjord.

3) The impacts of the mine development are confined to a single drainage.

Thank you

F M Smith

F M Smith

Copies to

Mr Robert S burd	Colonel Wilbur Gregory	Mr Bob Grogan
Director Water division	District Engineer	Director
Region X	U S Army Corps of Engrs	Office of the Governor
U S EPA	P O Box 898	Div of Governmental
1200 Sixth Ave	Anchorage AK 99506-0898	Coordination
Seattle Wash 98101		Pouch AM
		Juneau AK 99811

158

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a citizen who is concerned with the social and economic future of this great State of Alaska, I am writing to you to share my views of the Quartz Hill Project.

First, let me say that I firmly believe that the project can be accomplished with minimal effect on the ecosystem. From all the information I have seen, and that is quite a lot, U. S. Borax has shown that they fully intend to work the mine with the least possible disturbance to marine and wildlife.

It is easy to envision a huge company starting a mine, bringing jobs and cash flow to our little community. There is little doubt that Ketchikan will receive some of the financial fallout from this project. That part is all well and good, however, if it could not be accomplished under the proper guidelines, I certainly would not be in favor of it.

These guidelines are, of course, the crux of the problem. On the one hand, if they are too stringent, the mine could not operate feasibly. On the other hand, if too lenient, then perhaps our marine life could suffer.

I believe that the key word here is "Reasonable". These guidelines need to be reasonable for both sides. Environmental controls should be reasonable yet they must be balanced by economic considerations.

One consideration that I would like to show support for is the tailings disposal site at Wilson Arm/Smeaton Bay. I am happy to note that in the Revised Draft EIS the Forest Service preferred this site over the E.P.A.'s preferred alternative in Boca de Quadra.

In closing, let me say that I appreciate the weight placed upon yours and other's shoulders and do not envy you your jobs. Best of luck to you and with God's help, all concerned will end up happy.

Sincerely,

Larry Herrman

Larry Herrman

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

2325 TONGASS AVE.
KETCHIKAN, AK 99901

USDA FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

159

P.O. Box 324
Skagway, AK 99840
June 21, 1987

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, AK 99901

Mr. Johnson;

Regarding the renewed efforts to begin mining activities at Misty Fjords National Monument, I have some concerns about the environmental safety aspects of the project.

First, I urge that you follow the EPA recommendation, and insist that any tailings wastes be placed in the middle basin of Boca de Quadra, not in Wilson Arm. Similarly, Wilson Arm should not be used as a well field for water.

In addition, I oppose draining any supplemental water from the Blossom River, and I oppose any low dam system or weir that might impede fish movement.

If possible, I would like to see the project scrapped altogather. The National Monumeat is too beautiful to allow it to be pierced by the huge project that U.S. Borax has in mind. The project will have many unfortunate consequences on the area's fish, wildlife and recreational systems. If, however, the project is developed, it is incumbent that U.S. Borax pay all fair costs to create its mine; they should not be passed on to the U.S. taxpayers.

Thank you for your consideration of these points.

Sincerely,

Frank Norris

Frank Norris

USDA - FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUN 24 '87
FOREST SUPERVISORS OFFICE

160

5122 East Citrus Street
Tucson, Arizona 85712
June 22, 1987

Mr. Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

We urge that the Forest Service use the E.P.A. plan for using the Boca de Quadra fjord for the tailings from the Quartz Hill molybdenum mine.

It's bad enough to have an open pit mine in our beautiful Misty Fjords National Monument — at least we must minimize the impact as much as possible. Wilson Arm is too spectacular and important to take a chance on ruining it.

Sincerely,
Walter + Dorothy Pelech

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M&WS
RRL

161

CITY OF PORT ALEXANDER

Box 725 • Port Alexander, Alaska 99836

22 June 87

Mr. Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, AK. 99901

Dear Mr. Johnson:

When I moved to Alaska ten years ago, a commonplace phrase heard was, "here in Alaska we can do development right." And I used to think that was true. But current U.S. Borax plans make me wonder.

It would certainly be beneficial if Borax could mine, supply jobs, and stimulate the Southeast economy. But to do so at the expense of valuable fisheries resources is irresponsible, and unacceptable.

Here in Port Alexander the majority of us make our living by fishing. If U.S. Borax is not willing to accept the costs of doing their mining in an environmentally sound manner, this project should not be allowed to proceed.

We strongly oppose any dumping of tailings in Wilson Arm, and want the Wilson-Blossom River systems left alone.

Sincerely,

MJ Kirchhoff

Mark J. Kirchhoff
Mayor

cc: Governor Steve Cowper
Robert Burd, EPA
Col. Wilbur Gregory, Corps of Engineers

USDA - FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUN 24 '87
FOREST SUPERVISORS OFFICE

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June 22, 1987

Dear Mr. Ed Johnson,

I am concerned about the proposed Borax mining project in Misty Fjords National Monument.

I am opposed to the project in general on the grounds that a private (multi-national) mining company proposes to reduce their costs at the cost of local commercial fishermen , others affected by the fishing industry, and significant impact to the environment. Let's reduce impacts to the monument first!

If tailings must be dumped, I support the EPA's position to put them in the middle basin of Boca de Quadra-- not in Wilson Arm.

I oppose any tampering with the valuable water systems-- the Wilson and Blossom Rivers.

If the company will come to mine and bring jobs, very well, but they should be expected to pay a fair price and determine what will be the best way to get rid of the tailings--not just the cheapest. Especially if it's at a cost to fish and thefishing industry, and the water systems.

Has there been enough investigation into land based sites for the generated waste?

Let's have foresite and support what will be best for ongoing healthy resources and natural habitat.

Thank you very much.

USDA - FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

Sincerely,

Jill A. Armin

Jill A. Armin
Box 73
Sitka, AK
99835

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June 22, 1987

Mr. Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, AK 99901

Dear Mr. Johnson:

I am writing to express my strong opposition to the U.S. Borax proposal to dump mine tailings in Wilson Arm. An objective analysis of benefits and impacts should certainly show that any advantages gained by Borax will be more than offset by the loss of fishery resources by the people of Alaska. I am convinced that the Forest Service is wrong, and EPA is correct in this dispute.

The Wilson, Blossom and Keta Rivers desrve more protection than your agency has been willing to provide. I request that water withdrawals from these rivers, whether by well field or by any other means, be severely limited or eliminated from the mine plan.

The U.S. Borax project has received less scrutiny than warrented. I am not convinced that allowing it to proceed under the unenthusiastic oversight of your agency is in the best interest of our state or nation. The cost of doing business in 1987 should include the cost of protecting irreplacable resources. Until there is more evidence that the Forest Service and Borax agree, I am opposed to the project.

Sincerely,

William B. Britt, Jr.

William B. Britt, Jr.
2418 Oak Drive
Anchorage, AK 99508

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R. M. Massenburg
P. O. Box 841
Ward Cove, Alaska 99928

22 June 1987

U. S. Department of Agriculture
Forest Service
Federal Building
Ketchikan, Alaska 99901

Gentlemen:

I submit the following comments regarding the QUARTZ HILL MOLYBDENUM PROJECT MINE DEVELOPMENT. Inasmuch as I am a long-term resident of Ketchikan and intend to remain a resident for an indefinite period, I have a deep interest in this proposed facility and its impacts upon the community and the environment. Since I own a business in Ketchikan, I obviously favor those activities which will be economically advantageous to the community and which will not adversely impact upon our area beyond the incremental value to be realized; however, I am OPPOSED to the issuance of long-term permits for this project.

Throughout the "Revised Draft Environmental Impact Statement - Quartz Hill Molybdenum Project Mine Development" there are statements that the proposed project meets the present standards for environmental considerations, and/or that certain projections regarding impacts are based upon present knowledge and technology. It further infers that the market for molybdenum is improving to an extent that would bring the opening of the mine as a production facility to the proximate future. The last statement taken in light of the immediately foregoing statement are the basis of my opposition to the issuance of any long-term permits. I would not object to the issuance of permits for a period of seven years from the publication of the Final Environmental Impact Statement.

My present knowledge of the molybdenum market, while neither extensive nor absolutely precise, indicates that it will be a number of years before any production will be undertaken at this mine, a contention inferentially substantiated by the general absence of Borax employees in Ketchikan. A further indication is the fact that there are a number of mines which are fully developed and equipped which are not operating as of this writing. Given the costs of opening a new mine, the economics of the situation favor the opening of existing facilities before this facility would be started. Furthermore, I believe that not too long after Borax became interested in this facility, a rather large and rich molybdenum find was made in Africa - a place where labor costs are lower and consideration

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COMMENTS BY R. M. MASSENBURG - PAGE 2

of the environment is not as costly as it is in this country. Lastly, given that molybdenum is an element used primarily in specialty metals, which production is now in a decline in the United States, this facility would be required to operate in the export market (note that historically a large part of the United States' molybdenum production has been exported), and it seems unlikely that this facility would have a competitive value in the foreseeable future(i.e., 10 to 15 years, at least and probably significantly later).

#1

It is generally acknowledged that technology has increased two-fold each seven years since 1900. If this is accepted even as to its order of magnitude, the advances in technology may drastically alter the considerations now deemed germane to this Impact Statement by one or more of the following: (a) the need for molybdenum may drastically change; (b) mining methods may change drastically; (c) extraction technology may change radically; (d) other factors that may arise between this proposed permitting action and the opening of the facility may be such as to render presently acceptable environmental costs and risks unacceptable; and, (e) given that it was only about 20 years ago that mandatory consideration of the environment on an operational level came into being, I feel it is patently unwise to consider permit action under present laws and regulations, an operation that has been conceded to have an effect upon the environment, but which most probably will not come into being under these laws.

In summary, I am opposed to the proposed action unless all permits and licenses issued at this time mandate a full review and compliance with the laws and regulations in effect at such time that the proposed mine is to be entered upon as a production facility. I am of the opinion that, although Borax initially intended an early opening of the mine, economic considerations caused them to reconsider, and they then continued to seek permits in order to take advantage of the probability of obtaining less stringent permit requirements than would be true of a time nearer the opening of the mine for operation.

Sincerely,

R. M. Massenburg

R. M. Massenburg

cc: Alaska District, U. S. Army Corps of Engineers

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GREATER WASILLA CHAMBER OF COMMERCE
P.O. BOX 871826
WASILLA, ALASKA 99687
(907) 376-1299

June 8, 1987

Mr. Win Green, Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green,

The officers and Board of Directors of the Greater Wasilla Chamber of Commerce have directed that I write to express our support for the choice of Wilson Arm as a preferred alternative for the U. S. Borax Quartz Hill Project.

We have reviewed the re-issue of the Draft Environmental Impact Statement and considered the alternatives. We consider that the Wilson Arm alternative offers the best way to balance the environmental and socioeconomic issues.

We realize that Alaska needs to develop its mineral resources to supplement and diversify its total dependence on oil. We support the Quartz Hill project and believe that it should be given the best possible economic opportunity for development and the strongest possible competitive position in the world's molybdenum markets. We believe that the Quartz Hill project should be allowed to place their tailings in the Wilson Arm fjord.

Sincerely,

Mary Margaret Snyder

Mary Margaret Snyder
Executive Director

USDA FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUN 25 '87
FOREST SUPERVISORS OFFICE

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621 Pine Street
Ketchikan, AK 99901
20 June 1987

Mr. Win Green, Forest Supervisor
Forest Service, U.S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

Support ie being given to allowing U.S. Borax to dispose of tailings in Wilson Arm from their Quartz Hill development, by reason of:

1. Adequate safeguards to our fisheriee habitat ie provided within the exieting eectione of the Alaska National Interest Lands Conservation Act of 1980.

2. Good economic practice would not permit U.S. Borax officials to expend funde neceeeary to place the mine into production, providing for the tailings diepoeal in Wileon Arm, unlese management was convinced thie could be done without jepordizing the operation and subsequent lose of inveetment.

3. Adequate hearinge have been held over past years; it ie time to establish a manditory cut-off date for fruther delays, and to get on with the decision making procese. Alaska needs diversification of induetry with resultant increase of jobs and income; expansion of mining through affirmative action on U. S. Borax'e proposals without adverse consequencee to our valuable fiehing induetry is a progreseive step in thie direction.

Yours truly,

E. E. Smith

E. E. Smith

EES/do
cc: Mr. Robert Burd
Col. Wilbur Gregory
Mr. Bob Grogan

USDA FOREST SERVICE KETCHIKAN AREA
RECEIVED
JUN 25 '87
FOREST SUPERVISORS OFFICE

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3710 Ember Spring Drive
Kingwood, Texas 77339 - 5205
June 22, 1987

Dear Mr. Edward P. Johnson:

I wish to comment on the proposed molybdenum mine at Quartz Hill. I hope to visit Misty Fjords National Monument some day and I do not want to see it trashed up with mine tailings. Since they must go someplace, I must support the EPA and see them disposed of in Boca de Quadra fjord. I makes no sense to fill up a spectacular fjord (Wilson Arm), ruin an important salmon run, and have surface waters contaminated with resuspended tailings. The cost of using Boca de Quadra fjord is a cost of doing business in a manor that is socially and environmentally acceptable to us all.

Cordially,

Robert Markeloff

Robert Markeloff

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FS				
DFS				
PLN				
PAS				
AO				
LM				
ENG				
LSW				
MSWS				
RRL				

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June 22, 1987

Ginny De Vries
3106 W. 29th St.
Anchorage, AK 99517

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, AK 99501

Dear Mr. Johnson,

I am writing to you about Borax's mining project in Misty Fjords National Monument and to let you know I oppose any dumping in Wilson Arm and all proposals for a well field for water in Wilson River. I also oppose draining supplemental water from the Blossom River and the construction of a low dam system that would impede fish movement. In fact, I wonder if the Forest Service is keeping clearly in mind the fact that its duty is management of publid lands for protection of fish, wildlife and recreation resources for long-term sustainability.

I do not think the project should be approved, but if it is, Borax whould be expected to pay a fair price to mine and to leave the Wilson Arm and Wilson Blossom River System alone. I would like to know your thoughts on the subject.

Sincerely,

Ginny De Vries

Ginny De Vries

cc: Governor Steve Cowper
Robert Burd, Director
Col. Wilbur Gregory

USDA-FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

169

James F. and Edna L. Hatch
Box 438
Haines, Alaska 99827

June 22, 87

Ed Johnson
U.S.Forest Service
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Johnson:

This letter is to support the fisheries of the Wilson, Blossom and Keta Rivers, which are some of the main fisheries in SE Alaska.

We OPPOSE the dumping of tailings from the proposed "Borax" plan into Wilson Arm.

It seems so elementary. Fishing supplies jobs and supports communities. Fish supply food.

Why must jobs for locals and food for the world be sacrificed for a foreign owned company to make money?

Present law calls for settling ponds for mining. Why and exception? I don't care who they are. And so what if it costs them more? It will cost a lot of fishermen their entire livelihoods if the plan to dump in Wilson Arm is approved; and if water is diverted from the Blossom River and a weir constructed that would impede fish movement.

Part of your job is to protect our resources and our environment. Some things are irreversible. We feel this project will cause that kind of damage.

Sincerely: Edna L. Hatch
James Hatch

cc: Governor Steve Cowper
State of Alaska
Box A
Juneau, AK 99811

cc: Robert Burd, Director
Water Division, Region X
EPA
1200 Sixth Avenue
Seattle, WA 98101

cc: Col. Wilbur Gregory
District Engineer
Corps of Engineers
Box 898
Anchorage, AK 995506-0898

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Jeff Sauer
306 Main St
315
Ketchikan AK 99901

June 22, 1987

To Ed Johnson
US Forest Service

re: US Borax

Please accept this letter as my comments regarding the revised USFS position on the Misty Fjords - US Borax mine. As a citizen of southeast + more specifically Ketchikan I am strongly opposed to the Forest Service's reversal concerning tailings going into Wilson Arm. I see the revised position as not properly representing the citizens interests in maintaining the fisheries and recreational interests of southeast. I support EPA's insistence on tailings going into Boca de Quadra. US Borax went into this with their eyes open and now, to the detriment of southeast resources, are pressuring you into an environmentally unsound position. Multiple use is being sacrificed to the special interest of Borax + to economic blackmail. The environmental degradation is severe is simply not overcome by any economic necessity.

I am also in favor of maintaining this area as environmentally intact as possible; I oppose proposals for a well field for water in Wilson River, and draining supp. water from Blossum River and any river/dam.

This proposal in Misty Fjords is in general wrong for this national monument + forest. I am opposed to it, and at a minimum, to the Forest Service's bending over backwards to reduce costs to Borax at the expense of severe impact to national resources. If the project is

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allowed to go forward, however, I see no reason why Borax should not be expected to pay the price of not dumping in Wilson Arm.

Thank you for the opportunity to comment.

Jeff Sauer
Ketchikan AK

CC: Gov. Steve Cooper
Robt. Burd, EPA - Water Div
Col. Wilbur Gregory - Army Corps of Eng.

P. O. Box 71
Petersburg, Alaska 99833
June 22, 1987

Ed Johnson
U. S. Forest Service
Ketchikan Area Office
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I have been involved and concerned with the threat of the "Borax" mine since the beginning. I happened to be in the Ketchikan Area office, then the South Tongass, at the time the finding of the molybdenum deposit was reported by the U. S. Geological Survey and filed on by Rio Tinto Zinc, Inc. At that time all agreed it was too bad this deposit was there but that all developments should be confined to Boca de Quadra.

More recently an EIS was released by then Forest Supervisor Jim Watson with a preferred alternative calling for a "Keta" route for the road. As I wrote in January of 1982:

> "I consider it very strange that this DEIS has been released without a preferred alternative. This becomes even stranger when we know that there had been a preferred alternative and it was for the Keta route. The plot thickens further when we learn that immediately after this alternative was selected, responsibility was assumed by the Chief of the Forest Service and the preferred alternative was thrown out."

My suspicions as to the source and type of pressure put on the Forest Service then are reinforced by the publication of this revised Draft. This revision is an environmental horror. As the volume of the Environmental Impact Statements has increased so have the environmental impacts. This DEIS appears to have been written to the specifications of Rio Tinto, inc. It certainly represents more of a political decision than an environmental document.

What on earth happened to the ANILCA provision (Sec. 505 (a) to adequately protect the fishery? This proposal is the worst yet in having a maximum impact on the fishery. We have already had one serious landslide (that we have heard of) and others are certain to occur. Now we have additional proposals for damage to the fishery such as "de-watering" the Wilson and Blossom Rivers and even the construction of a weir and low dam on the Blossom. This is beyond belief! How, I ask, is this supposed to protect the fishery?

As for marine disposal of tailings, I am not in favor of dumping in either Boca-de-Quadra or Smeaton Bay. As I wrote in October, 1984:

> "While not as great a fishery as that of Smeaton Bay, I do oppose risking that of Boca de Quadra for the convenience of a multi-national corporation. If this is such a rich deposit on which Borax expects to make millions, then it is worth mining under stipulations that protect other resources.

> "Land disposal of tailings should not be dismissed. In spite of statements released by Borax, there is no assurance that dumping of wastes into Boca de Quadra will not seriously damage the fishery. This needs further study."

#1

Again, I ask the Forest Service to go back to the drawing board and make a thorough study of on-site disposal of tailings. If, after such a study has been done (and it has not been done as yet) then at the very least if such disposal is not feasible, the recommendations of EPA for use of the middle basin of Boca de Quadra be followed. I feel, therefore, that any decision on "ocean" dumping is premature.

The old issue of jobs is again being raised. We are being asked to approve the destruction of a major multi-million dollar fishery that with habitat protection will go on providing for jobs in perpetuity. We are asked to sacrifice this proven resource for the benefit of a foreign owned corporation to provide jobs for the life of the project. Sacrifice of the fishery for exploitation of a non-renewable resource will only prolong the "boom and bust" cycles of the economy that have plagued Alaska from the beginning.

And, what of the wilderness values of the Misty Fjords? Allowing the staggering development to proceed in Wilson Arm, in the heart of the Monument will destroy the very values for which it was created. And, what of the growing tourist industry this Monument has created? Do these jobs not count? What of the enjoyment of the area by residents and visitors alike? Certainly no one seeking a natural environment will ever visit Wilson Arm and it was one of our favorite areas. It was a true wilderness. Section 503 (f)(2)(A) required:

> "all mining exploration activities within National Monuments be in accordance with reasonable regulations promulgated by the Secretary to assure that such activities are compatible to the maximum extent feasible with the purposes for which the Monuments were established."

Providing for such massive developments in Wilson Arm, in the very heart of the monument, in no way complys with this section.

#2

This DEIS is unacceptable. In the first place it is premature because land disposal of tailings has not been thoroughly studied. At the very least an alternative must be chosen that removes all developments from the Wilson Arm and provides for the EPA alternative of dumping in the middle basin of Boca de Quadra. All possible developments should be confined to this one drainage. This revised draft has maximum impacts on both the fishery and the values of the Monument.

Sincerely yours,

Dixie M. Baade

Dixie M. Baade

cc EPA
Corps of Engineers
Governor Cowper

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071-0 YD-2-840015
Smeaton Bay 5

P. O. Box 71
Petersburg, Alaska 99833
June 22, 1987

Col. Wilbur Gregory
District Engineer
Corps of Engineers
P. O. Box 898
Anchorage, Alaska 99506-0898

Dear Col. Gregory:

As I have done many times, I again express my opposition to allowing Rio-Tinto Inc. (Borax) to discharge tailings and place its main developments in the Wilson Arm of Smeaton Bay.

To allow a foreign owned company to come in and exploit a non-renewable resource at the expense of a major domestic fishery is unconscionable.

The project description is of an environmental horror. The permit application is for the destruction of one of Southeast Alaska's major productive fisheries.

I recall that "Borax" was once quite ready to accept a road route up the Keta in Boca de Quadra. They started building the road before having a permit. I saw the beginning of this shortly after it was abandoned.

I was also informed by a member of the IDT that the Alaska District, Corps of Engineers some years ago granted a permit for developments in Boca de Quadra but was over-ruled and the permit issued for Smeaton Bay! It appears decisions are being made on political rather than environmental grounds.

My comments to the Ketchikan Area, Forest Service are enclosed. I list the aspects of this project to which I most object. I urge that this permit application be denied.

Sincerely yours,

Dixie M. Baade

cc Forest Service
EPA
Governor Cowper

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Alaska
Trollers
Association
130 Seward St., No. 213
Juneau, Alaska 99801
(907) 586-9400

USDA FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUN 25 '87
FOREST SUPERVISORS OFFICE

6/23/87

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, AK 99901

Re: Comments on the Quartz Hill Molybdenum Project Mine Development - Revised Draft Environmental Impact Statement

The Alaska Trollers Association (ATA) welcomes the opportunity to comment on the above cited revised draft EIS. The ATA is a non-profit, membership supported fishermen's organization representing the interests of the Southeast Alaska power troll fleet. The ATA has approximately 300 fishermen members and roughly 25 business associate members. Fishermen represented by the ATA fish in the waters which may be impacted should the proposed mine development take place, and are dependent for part of their livelihoods on fish stocks spawning in rivers which could be impacted by the project.

That we are commenting again on this issue of the Quartz Hill (old U.S. BORAX) generates a bad feeling of Deja Vu. We had felt that this issue had been laid to rest - many times. It seems that every time we feel we have a commitment for environmentally safe implementation of this project, the mining folks want to go back and retrench. Considering that this project is now owned by a British Empire mining conglomerate, I guess that we should expect it. At a recent meeting I attended, a British Columbia provincial bureaucrat cautioned that "in respect to natural resources, if there is a dollar to be made, you should not expect Canada to exhibit any environmental conscience; in this issue - we have no environmental morality." We believe that the United States, and companies who wish to operate within its borders, on the other hand should be required to exhibit wise stewardship.

Therefore, we strongly encourage you to accommodate ATA's concerns, which center on:

1.) the location of the tailings dump(s) for the proposed mine; and

2.) the mode of development of the permanent water supply system for the proposed mine.

Taking these two issues in order, the ATA prefers the Environmental Protection Agency's (EPA) preferred alternative for siting of the tailings dump. The EPA's selection of Boca de Quadra as the preferred site comports with our view that this site will minimize potential hazards to fish stocks. We would remind the Forest Service that location was agreed to by U.S. Borax in 1984 after extensive consultation with then Governor Jay Hammond. Such agreement was

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integral to the State's position to then give the "green light" to this development. The extensive research conducted by U.S. Borax respecting the possible effects of the tailings on fisheries resources not withstanding, the ATA still holds that the State's determination at that time was, and is valid. We believe it is in the longterm best interests of the public to site the tailings dump in Boca de Quadra.

Of even greater importance to fishermen is the question of the proposed well fields in the Wilson-Blossom River drainages. These rivers are major contributors to the fisheries resources of the Behm Canal system. Extensive efforts have been made - including catch reductions by fishermen - to assure rebuilding of these stocks. The proposed well fields pose a threat to these stocks. Spawning gravels used by the fish are critical habitat. Should they become dewatered because of draw down caused by water extraction through the well field major spawning habitats could be lost. Putting this risk, and the burden of proving any damage onto commercial fishermen is both unfair and unnecessary. A feasible, environmentally preferred alternative exists in elevating the dam level for the impoundment on Tunnel Creek. The ATA strongly urges the Forest Service to adopt this alternative in lieu of placing well fields in the drainages of major salmon streams.

Sincerely,

Earl E. Krygier

Earl E. Krygier
Executive Director

cc: Governor Steve Cowper
Robert Burd, Director EPA
Col. Wilbur Gregory - Corps of Engineers

173

Box 1001
Haines, Alaska 99827

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

This will be a short letter to let you know how I feel about your recent decision to allow the dumping of tailing in Wilson Arm by U.S. Borax.

Most significantly is the disruption that action would create on the fishery . Secondly, Wilson Arm is a unique wilderness zone that should be exempt from the dumping of tailings or any other heavy industrial activity. There are other places in the area where tailings could be dumped with a lesser impact. You should strongly consider requiring U.S. Borax to dump tailings in the middle basin of Boca de Quadra.

You should also seek alternatives to development of the Wilson or Blossom Rivers. They are vital salmon rearing streams that might suffer severe damage from any activity that would impede fish activity.

#1 Overall, The Forest Service should make serious efforts to investigate further dumping of mining tailings on isolated ground sites. It has often seemed like the Forest Service has made special advances toward Borax, while neglecting the primary purpose of of a national monument--making an investment into the future of the earth.

Thank you for taking the time to read this letter. Please be very careful when you make long-lasting decisions which impact our last remaining wildlands.

Sincerely,

Daniel Henry

USDA FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUN 25 '87
FOREST SUPERVISORS OFFICE

Craig, Alaska
June 24 1987

Mr Ed Johnson
US Forest Service, Federal Building
Ketchikan AK 99901

Dear Sir:
This letter concerns my views regarding Borax Mining proposed plans in the Misty Fjord area.
Tailings must not be dumped in Wilson Arm.
If they must be dumped - lets go for Boca de Quadra.
Why, cannot these tailings be dumped on a land base?
Water source from Wilson River and/or Blossom River will destroy valuable salmon spawning areas. #1
The State of Alaska should recieve a fair price for tons of mineral extracted from this area. #2

Sincerely
Gene H. Shorlo
PO Box 8969
Ketchikan AK 99901

cc to:
Governor Steve Cowper
Robert Burd, Director, Water Div, Reg. X, EPA
Col Wilbur Gregory, Dist Eng, Corps of Engineers

SOUTHERN SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION, INC.

1649 Tongass Avenue
Ketchikan, Alaska 99901
(907) 225-9605

June 24 1987

WIN GREEN
FOREST SUPERVISOR
TONGASS NATIONAL FOREST
KETCHIKAN AREA
FEDERAL BUILDING
KETCHIKAN, AK 99901

DEAR MR GREEN:

After reviewing the draft EIS for the Quartz Hill molybdenum project mine development, the SSRAA Board of Directors Executive Committee would like to make the following comments.

SSRAA is an organization which must consider the fishery resources as the primary concern when any development that has potential negative impacts to fisheries is proposed. Issues such as development costs and housing alternatives are considered secondary to protection of fishery habitat and, therefore, are not reflected in our comments. Two primary issues are of concern:

1. The Water Supply
2. Tailings Disposal

They concur with the Forest Service's preferred alternative of obtaining processing water from an impoundment on Tunnel Creek with the backup of supplemental water from a natural pool near the mouth of the Blossom River that may need to be weired to prevent salt water intrusion into the supply. All other alternatives are unacceptable because of fishery impacts.

They concur with the Environmental Protection agency preferred alternative on the issue of tailings disposal. Tailings disposal in the middle basin of Boca de Quadra appears to carry less risk to fishery resources than tailings disposal in Wilson Arm. The following concerns are the basis for the selection of Boca de Quadra:

1. The likelihood of suspended tailings reaching the upper water column of the middle basin of Boca de Quadra is probably less than that for Smeaton bay. The likelihood of exposure to organisms in the upper water column is, therefore, reduced. Although the risk to fisheries with exposure to tailings is uncertain, the Wilson/Blossom's fishery production is extremely important to Southeast Alaska fisheries and the conservative approach of disposal in the middle basin of Boca de Quadra would reduce the risk.

S.S.R.A.A.

2. The modification of the bathymetry of Smeaton Bay fjord and the associated changes to circulation and water column density structures may cause changes in the marine ecosystem. Since early marine residence for salmon species is extremely important to the overall production from an area, effects of ecosystem changes may be negative. Because of the large reservoir for tailings in the middle basin of Boca de Quadra, the effects from modification of the bathymetry will be considerably less than in Smeaton Bay.
3. The relatively large reservoir for tailings in the middle basin of Boca de Quadra allows for deeper discharge of tailings and reduces potential problems from elements such as copper and other metals associated with the tailings. It also allows for the tailings impact to be concentrated in one basin with a great deal of volume to spare. The volume of the Smeaton Bay reservoir does not allow for error in estimating the volume of tailings such that we are assured the tailings will be contained in the one basin.
4. Since the Smeaton estuary must support roughly three times the salmon production of the Boca de Quadra system, impacts to Smeaton Bay area potentially have a more serious effect on commercial fishery than impacts in Boca de Quadra. The conservative approach is to select Boca de Quadra as the basin for further development.

Based on the information in the EIS the executive committee feels that tailings disposal in the middle basin of Boca de Quadra reduces the overall risk to the salmon resources in the mine development area.

Thank you for the opportunity to comment.

For the SSRAA BOARD of DIRECTORS EXECUTIVE COMMITTEE,

Gary Freitag

GARY FREITAG
RESEARCH & EVALUATION MANAGER

RECEIVED
JUN 26 '87
FOREST SUPERVISORS OFFICE

SOUTHEAST ALASKA SEINERS
P.O. Box 9579
Ketchikan, Alaska 99901
(907) 225-5156

The Southeast Alaska Seiners appreciates the opportunity to comment on the U.S. Forest Service's revised draft environmental impact statement on the Quartz Hill Molybdenum Project Mine Development.

Fishermen who seine in Southeast Alaska form the membership of SEAS. Businesses, processors and crewmembers also participate as associate members. SEAS members are and have been very concerned about the proposed development at Quartz Hill because 5% to 10% of the salmon harvested in Southeast Alaska every year originate in areas that will be effected by the project.

There are four areas about which we will comment; tailings, water supply, townsite option, and mitigation. Our comments are directed towards the protection of salmon and salmon habitat.

TAILINGS

In the RDEIS (page xv) the USFS basically gives four reasons why it prefers the disposal of the mine's tailings in Wilson Arm. All four reasons require comment.

#1

1) **The effects of the tailings disposal would be similar whether the tailings are deposited in Wilson Arm or Boca de Quadra.** This is true only if there are no effects from tailings disposal, but it is not true if the disposal of tailings has significant effects. The Forest Service has made the assumption that there will be little (no significant) impacts on salmon from marine tailings disposal. This assumption seems to be based on a best case scenario, a scenario where benign tailings compact tightly on the bottom, not mixing with the upper water column. But we believe that the USFS should also consider every reasonably possible scenario since the actual effects of Quartz Hill tailings on the dynamic and prolific southeastern Alaska fjords are unknown.

#1 cont.

Certainly a possible scenario is that the amount of tailings will be greater and/or the degree of compaction will be less than anticipated thereby filling the intended space faster and more completely. It is also reasonably possible that the dynamics of circulation will cause the tailings to mix with the upper water column thereby disrupting the delicate balance in the estuarian ecosystem and destroying the available food sources for inshore migrating juvenile salmon. And it is possible that salmon or their food source will be damaged or killed by toxic elements in the tailings.

If <u>any</u> scenario occurs other than the best case scenario it would be far preferrable to place the tailings in the middle basin of Boca de Quadra because it is larger and much deeper than Smeaton Bay and because it is not nearly as productive.

But even if the best case scenario is the most likely scenario, it is still true that there is more at risk by dumping the tailings in Wilson Arm than there is in putting them in the middle basin of Boca de Quadra. And perhaps this risk alone might be worth taking, but the tailings are not the only risk of this mine's operation to the salmon in Wilson Arm or to the Smeaton Bay ecosystem.

#2

When the decision was made to allow the access road to be placed on the Smeaton Bay side of Quartz Hill it was inevitable that most of the mine's development would be on that side and not on the Boca de Quadra side. This meant that most of the environmental effects and risks would be on this side. <u>It was recognized at the time that the cumulative risk of these effects plus the dumping of the tailings would be too great and should not be taken. This recognition was the reason why the promise was asked for, and made, to put the tailings in Boca de Quadra.</u> This cumulative risk is not mentioned in the RDEIS. We believe that all permitting agencies should consider the <u>cumulative risk</u> of potentially environmentally destructive activities associated with the mine. It is the major reason that SEAS continues to oppose the dumping of tailings in Wilson Arm.

#3

2) **The impacts of the mine would be confined to a single drainage.** This would be a valid reason if the fjords were similar. They are not. Wilson Arm is a much more productive salmon area. Boca de Quadra is much larger and deeper. Wilson Arm has substantially more human visitation than does Boca de Quadra. The idea of confining the impacts to one drainage was originally proposed for Boca de Quadra. This made sense because of Boca de Quadra's greater ability to absorb impacts and because of it's smaller salmon production. It does not make sense for Smeaton Bay.

#4

3) **It reduces the impacts on wilderness values since it is not necessary to construct facilities for tailings disposal in the Misty Fjords National Monument Wilderness.** This is a bit specious. The entire mine is in the middle of Misty Fjords National Monument and in fact the only reason the Wilson

#4 cont.

Arm is non-wilderness is because of the molybdenum resource and the lobbying efforts of it's developers. If it makes sense to place a non-renewable resource open-pit mine, which is owned and operated by a non-United States controlled multi-national corporation in the middle of a wilderness area than it certainly makes sense to construct tailings disposal facilities in the wilderness in Boca de Quadra if it is more environmentally sound to do so than the alternative and if it reduces the risk to a renewable resource.

#5

4) **It would result in greater community stability for Ketchikan and Southeast Alaska because of reduced operating costs and lesser development costs compared to disposal in Boca de Quadra.** This is an assumption that may or may not be true depending on many unforseeable variables. SEAS thinks it is much safer to assume that cheaper production costs will increase the profits of the owners of the mine and that the price of molybdenum will be a far more significant contributor to continuous operation of the mine.

Even if the assumption that cheaper production costs will keep the mine open on a more regular basis is correct it must be pointed out that this may provide some short term stability in Southeast Alaska but may serve the opposite purpose for longer term stability. It may be that the cheaper it is for the owner to mine the molybdenum the faster he will pull that product out of Quartz Hill thereby shortening the life of the mine and reducing the years Ketchikan will be able to depend on that source of economic activity.

The notion that cheaper production costs balances the extra risk of putting the tailings in Smeaton Bay doesn't seem to recognize the contribution of the fishing community to the short and long term stability of Ketchikan's economy nor recognize that management of much of southern Southeast Alaska's pink salmon resource revolves around the production of the rivers and estuaries in Smeaton Bay.

The Forest Service looks at the history of molybdenum markets to defend it's preferred tailings disposal alternative. SEAS looks at the history of the destruction of salmon habitat by development in the Pacific Northwest and assumes that there will be significant loss of salmon production because of the development of the mine. Desiring to keep this loss at a minimum the Southeast Alaska Seiners strongly encourages the permitting agency to require the disposal of tailings in the middle basin of Boca de Quadra.

<u>WATER SUPPLY</u>

We agree with and appreciate the Forest Service's preferred water supply alternative of taking water for the mine from a large impoundment at Tunnel Creek. In fact we believe the Tunnel Creek water source should be maximized as the primary water source. It seems to be the least damaging of the feasible water supply alternatives. However we do not have enough information to make a judgement of whether or not supplementing this water source from the pool at the mouth of Blossom River when the mine is operating at capacity would protect major salmon production in the Blossom. A more detailed analysis should be made of this supplemental alternative. #6

Because of the potential damage to the largest pink salmon producing river in Alaska, SEAS does not want water taken from the Wilson River nor do we want a road built along or near it.

TOWNSITE OPTION

We agree with the USFS preferred alternative of not having a town on or near the site of the mine. We are convinced that it would be next to impossible to protect the salmon resource if a town were built in this area.

MITIGATION

#7

The RDEIS recognizes that "mitigation of impacts to fisheries would be necessary because the impacts of each of the project development alternatives would be substantial," (4-278) in the section on mitigation measures. However this section does not satisfy our concerns nor answer some of our questions about mitigation for the mine's effects on salmon and salmon habitat.

Two questions:

Who is going to pay for monitoring the effects of mine construction and operation?

Who is going to pay for mitigation measures?

We are concerned about the participation of the mine owners in parts of

#7 Cont.

the mitigation process. We suggest that deciding on whether or not impacts have occurred, on how to stop these impacts, and on what measures would be necessary to replace the loss should not be a matter of negotiation or politics. It should be a matter for professional biologists, environmental scientists, and fisheries managers to decide.

We are concerned that a mitigation process is not more clearly defined in the RDEIS and that there is no mention that a "mitigation team" will meet regularly. It should be made clear that closing the mine temporarily or for a longer term is certainly a mitigation option to be considered when there is an environmental problem.

Our greatest concern besides the effects of a disasterous oil spill or landslide is the accumulated negative effects of the mine's development. The accumulated impacts of tailings disposal, sedimentation from the open-pit mine and construction, oil spills, tanker and barge traffic, and the increased presence of humans may cause long term degradation of the salmon environment and a long term significant reduction in the productivity of the area. Because of the natural cycles of salmon it will be difficult to prove (especially to those who might have to pay for mitigation measures) that the mine is responsible for this reduced productivity. SEAS is concerned that these accumulated effects will be recognized too late by the monitoring and mitigation process. The final EIS should identify a process for determining this occurrence as soon as possible and provide for the appropriate mitigation.

In conclusion, we believe the USFS should not overestimate the positive effects of the mine on the local, state, and national economy nor should it underestimate the negative effects of the mine on the community of Ketchikan and on the salmon resource in the Quartz Hill mining activities, SEAS believes the USFS should select the middle basin of Boca de Quadra as the preferred alternative for tailings disposal and do everything necessary and feasible to protect the salmon resource and to further define a viable mitigation process.

John Peckham
John Peckham
President

Ruth M. Zencey
R. D. 1, Box 254
Middletown, Delaware 19709

June 1987

Edward P. Johnson
U.S. Forest Service
Ketchikan AK 99901

Dear Mr. Johnson:

I wouldn't like to think that a beautiful bay is going to be spoiled to help U.S. Borax make more profits. They're doing fine already + don't need to destroy Wilson Arm (and its fishery) to make more money. If they have to do their darn mining let them at least not mess up more of Alaskas beauty with their tailings.

Sincerely
Ruth Zencey

USDA FOREST SERVICE
KETCHIKAN AREA
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FOREST SUPERVISORS OFFICE

Mrs. Ralph H. France
2 Acorn Circle, Apt. 301
Baltimore, Maryland 21204

22 June 87

Mr Edward P Johnson
US Forest Service
Federal Building
Ketchikan Alaska 99901

Dear Mr Johnson:

Whatever else you are involved in now must be put on hold until after you tackle the Misty Fiords - Quartz Hill Plan.

Please don't let the US Borax Corp.'s campaign change EPA's mind about tailings from the Quartz Hill molybdenum mine. The Forest Service wants to put them in Wilson Arm, a spectacular fiord that supports one of Alaska's most important salmon runs. EPA wants them put in the far larger and less productive Boca de Quadra fiord. I hope you are supporting that Boca de Quadra fiord, even if it might cost the US Borax Corp. a bit more money!

PLEASE work for the use of the Boca de Quadra fjord!!! Thank you.

Yours truly,
Madeleine S. France

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FOREST SUPERVISORS OFFICE

June 23, 1987

U.S. Department of Agriculture
U.S. Forest Service
Attn: Mr. Win Green, Forest Supervisor
Tongass National Forest Federal Building
Ketchikan, AK 99901

Re: Comments on the revised draft EIS, Quartz Hill, Molybdenum Mine Project

Dear Mr. Green:

Before I comment on this project allow me to introduce myself. I am a resident of Alaska and an officer with National Bank of Alaska, and I have enjoyed this fine state for over ten years. As an avid outdoorsman I spend much of my free time enjoying our vast wilderness and, like most Alaskans, I choose to live here through good and bad economic times because of the enjoyment I get from the Alaska outdoors.

This being said, I would like to make it clear that I believe in the wise use of natural resources both renewable and nonrenewable. In order to continue living in Alaska we must have reasonable development of our natural resources. From the description and development plans of U.S. Borax as outlined in the draft revised EIS it is clear to me that the Quartz Hill mining operation will be accomplished in an environmentally responsible manner.

The socio-economic benefits far exceed the impact on the environment and the trade-offs seem to be clearly in favor of the mining operation. Further delays or increased costs will do the people of Alaska, particularly the Ketchikan area, a great disservice.

I support the following alternatives:

1. The Forest Service preferred alternative for tailings disposal in the Wilston Arm.

2. The Borax plan for providing a reliable water source to assure continued operation of the mine during droughts.

3. The Forest Service preference for on-site electrical generation; however, a southeastern Alaska electrical power intertie with British Columbia should be encouraged to assure continued electrical supply and provide infrastructure to help increase the availability and reliability of power in the region.

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U.S. Department of Agriculture
June 23, 1987
Page Two

I urge the EPA to please reconsider its position on the tailings disposal in the Boca de Quadra. Cost is a very important factor and should be considered when evaluating the EIS. Only profitable operations will assure mining in an environmentally responsible manner. Unprofitability due to excessive regulation and unreasonable precaution can lead to cheating and damage. It is in the public's best interest to allow this mine to be operated profitably and in an environmentally responsible and reasonable manner.

Sincerely,

James L. Cloud
Vice President

gs

8301 E. 130TH
ANCHORAGE, AK 99516

180

USDA - FOREST SERVICE
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FOREST SUPERVISORS OFFICE

June 22, 1987

Dear Edward Johnson,

The Forest Service has released a revised draft environmental impact statement for the molybdenum mine at Quartz Hill in the middle of Misty Fjords National Monument. It is projected that the mine will generate over eighty thousand tons of tailings each day it operates. The single most important environmental issue may be where to place the tailings after mining. The Forest Service wants to put them in Wilson Arm, a fjord that supports one of Alaska's most important salmon runs. EPA opposes this site because the fjord may not be big enough to contain all the tailings, in which case the tailings would be resuspended and surface waters would be contaminated. It prefers the far larger and less productive Boca de Quadra fjord.

I am writing you to state my support for the EPA position. Since there is a better alternative with less environmental risks the tailings should be put there where the EPA reccomends. Thank You.

Sincerely,
Ronald Hocking

RONALD HOCKING
121 DECKER ST.
VALLEY STREAM, N.Y. 11580

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE COMPTROLLER

June 23, 1987

Win Green, Forest Supervisor
U.S. Department of Agriculture
Tongass National Forest
Federal Building
Ketchikan, AK 99901

Dear Sir:

This is in reference to your Draft Environmental Impact Statement on the Quartz Hill Molybdenum Project Mine Development. Enclosed are comments from the National Oceanic and Atmospheric Administration.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham
Ecology and Conservation Division

Enclosure

cc: Bohne

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 1668
Juneau, Alaska 99802

June 18, 1987

Win Green, Forest Supervisor
U.S. Department of Agriculture, Forest Service
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

The National Marine Fisheries Service (NMFS) (Alaska Region and Auke Bay Laboratory) has reviewed the Revised Draft Environmental Impact Statement (RDEIS) for the Quartz Hill Molybdenum Project and offers the following comments pursuant to the provisions of the National Environmental Policy Act and the Alaska National Interest Lands Conservation Act of 1980, Public Law 96-487.

General Comments:

The NMFS has been a cooperating agency with the planning and development of the proposed molybdenum mine at Quartz Hill throughout the process. We have studied the RDEIS at length and compared amendments and changes in it to the Draft Environmental Impact Statement which we commented on 25 September 1984. With minor exceptions, we find the RDEIS to be complete in terms of identifying alternatives and resource impacts associated with the various optional development plans and, therefore, sufficient information upon which to make a decision. The issues raised by our comments should, however, be addressed in the final environmental impact statement.

The development options which we feel would combine to form the environmentally preferable alternative for project development include: marine tailings disposal in the Middle Basin of Boca de Quadra, construction of a 175 foot dam with storage capacity of 8,940 acre feet on Tunnel Creek with no more than 36 cfs of supplementary water to be pumped from the confluence pool near the mouth of Blossom River, and workers living at single status housing at the project site and commuting during days off to Ketchikan.

We agree with the reasons stated in the Environmental Protection Agency (EPA) report, A Best Professional Judgment Evaluation Using the Ocean Discharge Criteria For Mill Tailings Disposal From the Proposed Quartz Hill Mine In SE Alaska (BPJ) (Appendix S, page vi) for Boca de Quadra middle basin discharge as the environmentally preferable method of discharge. Middle Basin

discharge is overall, the best alternative with the least risk for short-term and long-term impacts on the marine environment. In addition to the advantages offered by the EPA, only one basin within Boca de Quadra will likely be impacted, impacts will likely be below the 150 m depth, the risk for impacts in the phototrophic zone are less, fewer species will potentially be impacted, and there will be less potential for impacts to the herring stocks. Several oceanographic and topographic factors make disposal to the Middle Basin less risky: Middle Basin waters are always more stable than Inner Basin waters (p. 4-65) allowing less potential for the plume to reach the photic zone, turbidity impacts to Inner Basin are considered significant because of the low volume of the Inner Basin (P. 4-59), and large slumping events could have sufficient momentum to carry tailings material up adverse slopes, especially in the relatively confined Inner Basin (P. 4-45).

We recommend supplemental water to the Tunnel Creek reservoir be pumped from the confluence pool on the Blossom River. U.S. Borax personnel have stated (meeting April 29, 1987, in Governor's Conference Room) that sufficient water could be obtained via this pool. We see no reason to authorize construction of a well field on the Wilson River given the major associated construction impacts and risks of dewatering valuable salmonid habitat.

#1 The potential of leaching of metals from the tailings seems to be a subject inadequately addressed. Zn, Ni, and Cu are mobilized from sediments when reducing conditions develop in the sediment/-water boundary layer (Forester and Whitman, 1979, p. 253). In the discussion of leaching, a pH of 8 is considered as the most likely environment to be encountered. Reducing conditions in the interstitial sediment water are very likely to occur and in fact reducing conditions have been reported as occurring in the Middle Basin of Boca de Quadra at certain times of the year. Why then should the consideration for leaching potential be made only at pH 8?

#2 The question of uptake of metals by biota from the tailings seems to be unresolved, yet the RDEIS leaves the reader with the impression that uptake of metals is very unlikely. Other studies cited in the RDEIS have shown uptake of certain metals by biota. Why assume conditions at the Quartz Hill development will be so different that uptake will not occur?

#3 The toxicity information provided in the RDEIS is insufficient to evaluate the acute and sublethal effects on the biota as is stated in the RDEIS. We suggest consideration be given to repeating the described tests in such a manner that adequate information is attained because of the importance of this question.

#4 The probability and frequency of ruptures in the tailings

#4 (Con't) pipeline and malfunctions of the tailings discharge apparatus remain superficially addressed in the RDEIS. We think the possibility of serious impacts is great enough to warrant a model being run which would predict frequency and effects of accidental tailings discharge into surface waters.

Specific Comments:

#5 p. 3-89 2nd para: Flatfish density should be kg/km squared.

#6 p. 3-101 1st para: We feel it is unlikely migration of Tanner crabs would be limited to 15 miles. There are not data available to warrant speculation to the effect that crab from Boca de Quadra spend their entire life within Boca de Quadra.

#7 p. 3-101 3rd para: "Cryptomonas" rather than "Crytomonas".

#8 p. 4-74 6th para: It says: "As discussed in Section 4.1.6.2, impacts from a pipeline rupture are considered insignificant." Pipeline rupture impacts are not, however, discussed in the referenced section. Further, we feel a pipeline rupture has the potential of adversely affecting a yearclass of salmon if it were to occur during the spring phytoplankton bloom.

#9 p. 4-129 2nd para: Herring are a major prey organism in marine waters in Alaska. It is highly unlikely they would be of less importance in Boca de Quadra. It is incorrect to say that losses of herring would have no significant food chain effect.

#10 p. 4-132 1st para: "None of the metals are biomagnified ---" This statement is unclear because on p 88 of the EPA-BPJ it states that biomagnification of cadmium has been reported at lower trophic levels (primary producer to grazer).

#11 p. 4-135 2nd para: Adult spot shrimp normally occur in water deeper than 100 meters. Is it possible these were juvenile spot shrimp or some other species?

#12 p. 4-137 2nd para: How much polypropylene from the plastic pipes will enter the marine environment from pipe "wear" over the lifetime of the project? Any environmental effect?

#13 p. 4-283: Gravel Cleaning. Technically, this section may be correct but the tone should not imply such techniques are state-of-the-art and routinely applied. A natural stream contains an intricate assortment of habitats: undercut areas, deep pools, riffles, deposits of large organic material, bedrock, silt deposits, live vegetation, falls, boulders, braided areas, etc. A bulldozer or hydraulic gravel cleaner cannot just motor around and clean the sediment from the gravel. In reality, more damage can be done to the habitat than repaired, and more mechanical challenges encountered than overcome. In 1987 gravel cleaning does not exist as a routine procedure for application in the remote, natural, complex stream. Advances are occurring, however, and we are content to recommend the concept of gravel cleaning be reevaluated if and when construction occurs.

#14 Appendix R p. 96: The comment that dumping of tailings into the deep middle basin of Boca de Quadra would have less impact on diving birds and mammals was not addressed in the RDEIS. This may be quite an important point.

Thank you for the opportunity to comment.

Sincerely,

Robert W. McVey
Director, Alaska Region

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 1668
Juneau, Alaska 99802

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June 18, 1987

Mr. Don Kohler
Chief, Permit Processing Section
U.S. Army Corps of Engineers
Alaska District, Regulatory Branch
P.O. Box 898
Anchorage, Alaska 99506-0898

Attn: Gene Augustine

RE: Smeaton Bay 5
2-840015

Dear Mr. Kohler:

Reference is made to the subject Public Notice dated May 1, 1987, regarding an application by United States Borax and Chemical Corporation on behalf of the Pacific Coast Molybdenum Company to construct a marine terminal, anchor a floating camp, place mooring buoys, construct an open pile wharf, widen the existing access road, construct new roads, construct a water well field in the Wilson River, place a water supply pipeline from the well field to a 52 foot high dam on Tunnel Creek, and construct a tailings outfall and associated facilities in Wilson Arm of Smeaton Bay.

The National Marine Fisheries Service (NMFS) has reviewed the subject public notice and associated Revised Draft Environmental Impact Statement (RDEIS) prepared by the USDA Forest Service, Environmental Protection Agency, and Department of Army. This is a necessarily complex and controversial project with potential for major impacts to marine, anadromous, and estuarine resources for which we are responsible. The following are our comments and recommendations.

Marine Terminal: Construction and modification of the marine terminal will require conversion of approximately 10 acres of inter- and subtidal habitat into uplands through placement of fill. This shoreline is used by outmigrating salmonids in the early spring. Excessive turbidity and recently disrupted bottom habitat could combine to reduce the availability of food organisms which the juvenile salmon rely on during estuarine outmigration. The marine terminal includes a subtidal area of approximately .5 acre, stabilized with fill, upon which to ground construction barges during initial plant construction and during expansion some years later. Minimal use of this pad may best promote recolonization by benthic organisms and algae. To minimize adverse impacts to salmon, we recommend the following special conditions be placed on the Department of Army permit.

1. No in-water construction during the period April 1 through May 31.

2. After an initial use period of three years, retain, without use or maintenance, the 280'x80' subtidal pad.

Water Well Field: We recommend the request for construction of a Wilson River well field be denied. The Wilson River provides habitat for major runs of pink, chum, coho, and Chinook salmon. Withdrawal of water via the well field could have detrimental effects on the continued production of salmonids. An alternative source of supplementary water, the confluence pool on the Blossom River, is presented in the RDEIS and has been indicated as acceptable to the Applicant. A modified Public Notice should be circulated detailing any work within the Blossom River.

Access Roads: We recommend denial of the proposed access road into the Wilson River and the associated bridges over the Blossom and Wilson Rivers. In absence of the Wilson River well field, the associated road and bridges will be unnecessary.

Water Supply Dam: The mechanisms to provide low flow drainage into Tunnel Creek are not depicted on drawing 25. We are unable to determine the point of entry for the minimum flow stream releases. During periods of no reservoir replenishment will it be possible to drain the reservoir below the normal minimum elevation of 524 feet? Will the water reenter Tunnel Creek at the base of the dam into the existing streambed or at the base of the spillway discharge channel? This information is important because it will be necessary to release minimum flows into Tunnel Creek for protection and continued production of the salmon runs. Further, since mixing Blossom River water with Tunnel Creek discharge could attract Blossom, and perhaps Wilson River spawning stocks into Tunnel Creek, it will be necessary to avoid discharging Blossom River water through Tunnel Creek during the spawning period. We recommend these concerns be addressed by placing the following special conditions on the Department of Army permit:

3. No discharge, through Tunnel Creek, of water obtained from the Blossom River during the period July 1 through September 30.

4. Maintain the following minimum flows in Tunnel Creek:

July 1 through November 30	(for spawning)	90 cfs
December 1 through March 30	(for incubation)	15 cfs
April 1 through June 30	(for rearing)	30 cfs.

Tailings Outfall and Associated Facilities: The NMFS remains opposed to discharge of mine tailings into Smeaton Bay. We recommend the request for tailings outfall and associated facilities be modified to reflect discharge via tunnel to the Middle Basin of Boca de Quadra (See attached letter). A modified Public Notice should be circulated detailing the tailings outfall and associated facilities in the Middle Basin of Boca de Quadra.

Other Facilities:

Sediment Control Dams: We have no objection to the sediment control dams as proposed. If sediment builds up in the reservoirs, threatening overflow into the stream systems, the permitee should be required to remove the sediment to an approved upland location.

Mine Personnel Housing: No objection

Mine Service Facility: No objection

Log Transfer Facility: We have no objection to use of the existing wharf facility for short-term log transfer by the method of floating log bundles off skid logs at high tide.

Our review and comment on this permit application do not constitute the full public interest review or cumulative impacts assessment required of the Corps of Engineers. We are, however, willing to assist you with those living marine resource issues identified during the public interest review process. Should you determine that issuance of this permit without the above recommended special conditions and major modifications is in the public interest, we may seek resolution of the matter through the formal elevation process described in the Memorandum of Agreement between Departments of Army and Commerce. Accordingly, we should be notified of your decision in this matter.

Thank you for the opportunity to comment.

Sincerely,

Robert W. McVey

Robert W. McVey
Director, Alaska Region

NMFS contact person: Tamra Faris

cc: ADFG, Douglas, Ketchikan
ADEC, Juneau
ADNR, Juneau
FWS, Juneau, Anchorage, Ketchikan
Applicant, Ketchikan, San Francisco
AK Div. of Governmental Coordination, Juneau
EPA, Anchorage, Juneau, Seattle
USDA Forest Service, Ketchikan

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Alaska Wyldewind Charters

7 KATLIAN B-33 ~~BOX 2204~~ SITKA, ALASKA 99835
(907) 747-5734 S/V WYLDEWIND WRM 8097

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June 23, 1987.

Ed Johnson
U.S. Forest Service
Federal building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I was very disturbed to learn of the U.S.F.S. approval of Borax's dumping of mining tailings into Wilson Arm! I would hope that the E.P.A.'s lead would be followed, which is to direct these extensive tailings into the middle of Boca de Quadra, where their effect would be minimal. Although it may cost more to do so, the protection of Wilson Arm and the rich fisheries it supports, deserves it! It is my belief that the cost of foreign resource exploitative operations, such as Borax, should be to minimize the damage they create in Alaska. The incredible runs of salmon in the Wilson and Blossom river systems should be protected at all costs!

I feel that the U.S.F.S. have been inattentive to their role of managing public lands for public use and protection of fish, wildlife and recreational resources as far as Borax is concerned to date. It is well past the time to show that the USFS is standing up to the actual meaning of "multiple use" and not just acting as a public relations front office for Borax/interests in S.E. Alaska. The USFS can show its concern over these valuable river systems and the habitat they provide for salmon by making Borax choose the more costly but environmentally more sound alternative of dumping in the middle of Boca de Quadra.

Sincerely
Capt. Terry Dzugan

183

INSTITUTE OF MARINE SCIENCE

UNIVERSITY OF ALASKA-FAIRBANKS
FAIRBANKS, ALASKA 99775-1080

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June 23, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green,

I am writing with respect to the Quartz Hill Molybdenum Project. The Institute of Marine Science was heavily involved in the environmental studies of Smeaton Bay/Wilson Arm and Boca de Quadra, and as a result, we know more about the physical and chemical oceanography of these waters than is known about any other fjords in Alaska. A great deal of knowledge is synthesized in the Environmenal Impact Statement.

Although I personally visited the site, I was not involved directly in the research, and must rely on the scientists who conducted the work. They do not feel that the project would do serious harm, and are in general supportive of it. You will receive their comments on the EIS separately.

I believe that this project would be of significant benefit to Alaska, and hope that the necessary permits to proceed will be forthcoming.

Yours sincerely,

Vera Alexander

Vera Alexander
Director and Professor
Institute of Marine Science

VA:nw

cc: R. Burd, U.S. E.P.A.
W. Gregory, U.S. Army Corps of Engineers
B. Grogan, Office of the Governor

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Haverhill Mass.
June 23, 1987

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Edward B. Johnson,
U.S. Forest Service,
Federal Building
Ketchikan, Alaska 99901.

Dear Mr. Edward B. Johnson:

The single most important environmental issue may be where to place the tailings after the mining. The Forest Service wants to put them in Wilson Arm, a spectacular fjord that support one of Southeast Alaska's most important salmon runs. EPA oppose this site because the

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Mr Edward B. Johnson:
June 23, 1987
Page Two.

fjord may not be big enough to contain all the tailings, in which case the tailings would be resuspended and surface waters would be contaminated. It prefers the far larger and less productive BOCA DE QUADRA FJORD. I support the EPA's position.

Sincerely
John Mc Clurkin

activist
Sierra Club.

[redacted]

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3105 BROOKSIDE DR #11
ANCHORAGE, ALASKA 99517
JUNE 23, 1987

MR. ED JOHNSON
U.S. FOREST SERVICE
FEDERAL BUILDING
KETCHIKAN, ALASKA 99901

DEAR MR. JOHNSON;

I AM WRITING REGARDING THE PROPOSED DECIMATION OF THE WILSON ARM SALMON FISHERIES BY U.S. BORAX. I DON'T BELIEVE STRIP MINING HAS A PLACE IN A NATIONAL MONUMENT; I FURTHERMORE THINK IT WOULD BE A SERIOUS MISTAKE TO REPLACE A RENEWABLE RESOURCE INDUSTRY WHICH HAS PROVIDED JOBS FOR MANY YEARS WITH A RELATIVELY SHORT TERM INDUSTRY BASED ON A NON-RENEWABLE RESOURCE. THE FISHING INDUSTRY WILL CONTINUE TO PROVIDE JOBS TO THE AREA IF WE PROTECT THE FISHERIES. U.S. BORAX SHOULD NOT BE ALLOWED TO USURP THE WATERS OF THE WILSON AND BLOSSOM RIVERS; U.S. BORAX MUST NOT BE PERMITTED TO DUMP

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ITS TAILINGS IN WILSON ARM.

THE FOREST SERVICE SHOULD NOT BE IN THE BUSINESS OF PROMOTING MINING AT ANY COST. THE MISSION OF THE FOREST SERVICE IS MULTIPLE USE MANAGEMENT OF PUBLIC LANDS, MEANING FISH, WILDLIFE, AND RECREATION RESOURCES MUST BE PROTECTED AND NOT SACRIFICED FOR A SINGLE USE SHORT TERM GAIN.

THANK YOU.

Kenneth V Morton
KENNETH V. MORTON

C.C.
GOV. STEVE COWPER, STATE OF ALASKA
ROBERT BURD, DIRECTOR, REGION X EPA
COL. WILBUR GREGORY, CORPS OF ENGINEERS

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USDA - FOREST SERVICE
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4103 Blackerby St
Juneau, AK 99801
June 24, 1987

Dear Mr. Johnson:

I am writing to express my concerns over the Forest Service's recent decision reversal that would permit the dumping of U.S. Borax mine tailings from its Quartz Hill project into the waters of Wilson Arm. This decision not only jeopardizes the salmon fisheries of this body of water but also flies in the face of the EPA's recommendation that tailings be put in the middle basin of Boca de Quadra. It seems to me that the Forest Service is overlooking its responsibility to minimize mining impacts on the rest of Misty Fiords Monument and on the rich fisheries of Wilson Arm and is simply caving in to industry pressures to reduce costs of the proposed mining project. Where is the balance in truly managing our National Forests from a multiple use perspective that protects fish and wildlife habitat for the long term? Certainly not in permitting a project on public lands for private profit that ultimately degrades another valuable Alaskan resource.

Sincerely,

Randall H. Wiest

187

Win Green
Forest Supervisor
U.S. Forest Service
Ketchikan, Alaska

June 25, 1987

We, the undersigned, support the development of the U.S. Borax molybdenum mine in the Wilson Arm/Keta River area of the Tongass National Forest. We feel that this mine can be developed with reasonably little impact to the environment. It is important for the Country, the State, and our families that such projects be implemented in order to secure a good economic future for us all.

Name	Address	Telephone
1. Ronald Arntzen	4100 Tongass	247-1359
2. Inga Chapin	PO Box 6075	225-3922
3. Don Jeffords	201 Martin	225-6265
4. Robert Johnson	1931 First Ave	225-2574
5. [illegible]	PO Box 6075	225-3922
6. J.R. Meskimen	P.O. Box 231 Thorne Bay, AK	
7. Doug Wallin	3320 1st St	225-3075
8. [illegible]	1200 Woodside Dr	225-4763
9. Bryan Gardiner	Box 606 Ward Cove 99928	247-1363
10. Edward R. [illegible] Jr.	Box 7384 Ketchikan AK 99901	247-0182
11. Mike Chomka	P.O. Box 7395	225-8203
12. A. Rufand	P.O. Box 5335	
13. [illegible]	3817 Alaska Ave	225-3681
14.		
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VERN R. STARKS, D. V. M.
RT. 1, BOX 863
KETCHIKAN, ALASKA 99901
TELEPHONE 907 - 247-2820

June 15, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Deptment of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I would like to comment on U.S. Borax's Quartz Hill molybdenum project. I have lived in the Ketchikan area for over twenty years. As a private pilot and a boater, I am very familar with the area. I have goat hunted the Smeaton area drainage. I am familar with the history of the Tongass Forest Managment Plan, the Alaska National Interest Land Act, the proposed boundries of the Misty Fjords Wilderness area, the filing of U.S. Borax mining claims at Quartz Hill, the realingment miles south of the Misty Fjords Wilderness boundries to encompass and constrict if not kill any development of U.S. Borax's claims, the multi-use concept of the Tongass, and the economy of Alaska and Ketchikan in particular.

I was pleased that the Forest Service concluded that Wilson Arm would be the most viable area for tailing disposal from the mine. This leaves the Boca de Qudra area free of any development within that seclued wilderness area. The tailings pipeling would be much shorter, be less disruptive to the enviroment, and it also would be a sizable reduction in development cost amounting many millions of dollars. The cost difference between the two sites could well determine if the mine can be developed. U.S. Borax has spent over 100 million dollars researching this deposite for content, volume, and enviromental impact, so they have adaquate date to support their projections.

Three years ago next month, LPK--the major employer of our area, closed down operations for nine months. When employees returned to work, they did so at reduced wages. The effects of that shut-down are still felt. Estabilished businesses have went bankrupt and many families moved away. Our community needs more diversity of productive jobs. The Quartz Hill mine would provide a different, non-timber based industry. Ketchikan's economony has been precarious since 1980 along with the rest of the timber industry. Now the state's dire finicial crisis (900 million dollar deficit) has compounded our local funding problems. The borough millage rate has increase from 1 mill to 5.7 mills. Quartz Hill would benifit both Alaska and Ketchikan.

Thank you for your support for the Wilson Arm disposal and any future assistance you can give our community in realizing the development of the Quartz Hill mine.

Sincerly yours;

Vern R. Starks DVM

Vern R. Starks, DVM

cc. Mr. R.S. Burd, Director
Water Division, Region X
U.S. Environmental Protection Agency
1200 Sixth Ave.
Seattle, Wa. 98101

Col. W. Gregory, District Engineer
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, Ak 99506-0898

Mr. Bob Grogan, Director
Div. of Govermental Coordination
Pouch AM
Juneau, Ak 99811

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June 22, 1987

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KETCHIKAN, AK 99901

Mr. Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

This letter contains my comments and recommendations with respect to the Forest Service's revised draft environmental impact statement for the Quartz Hill molybdenum mine within Misty Fjords National Monument. Please consider my input and include this letter in the appropriate public record.

At the outset, I am greatly disappointed with the Forest Service's proposal to place mine tailings into Wilson Arm. Wilson Arm is a magnificent fjord which supports one of southeast Alaska's most productive salmon runs.

Since the Quartz Hill open pit mine will generate over 80,000 tons of tailings each day, there is a serious threat that Wilson Arm will not be able to contain all of these tailings, and surface waters and fisheries will be harmed.

In contrast, the risks to surface waters and fisheries are substantially less at the much larger and less productive Boca de Quadra fjord.

Please change the Forest Service proposal to require that the Boca de Quadra fjord be used for the placement of any mine tailings. In addition, please support and work to implement EPA's recommendations on this matter.

Thank you very much for considering my views.

Sincerely,

Richard Spotts

Richard Spotts

RS/js

5604 Rosedale Way
Sacramento, CA 95822

190

1001 Noble
Fairbanks, Alaska
22 June, 1987

Mr. Ed Johnson, U.S.F.S.
Dear Mr Johnson:

I have closely followed all developments in the Tongass National Forest since I first came to Alaska in 1962. I am keenly interested in any deleterious effects which large-scale development may have on the scenic and/or biological qualities of the Tongass. Regarding the U.S. Borax proposed mine, I am concerned that the proposed roading, dumping and water diversion in the Wilson River – Wilson Arm area will adversely affect the fisheries there. It will certainly affect the wilderness quality. Boca de Quadra would be a

#1 more suitable site. Has consideration been given to a land-fill rather than ocean dumping?

Sincerely
Ralph A Wells

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SIERRA CLUB - REDWOOD CHAPTER

~~P. O. Box 466, Santa Rosa, Ca. 95402~~

SIERRA CLUB - REDWOOD CHAPTER
CONSERVATION COMMITTEE
Ron Guenther
29900 Highway 20
Fort Bragg, California 95437

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KETCHIKAN, AK 99901

June 23, 1987

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

RE: Proposed Quartz Hill Mine - Misty Fjords National Monument

Dear Mr. Johnson and U.S. Forest Service:

Q-152 The 6,000 members of the Sierra Club's Redwood Chapter have made Alaska conservation issues one of their top conservation priorities. Many of our members have visited Alaska. Some have returned with magnificent slide shows and glowing reports of Alaskan national parks, monuments, and wilderness.

We are very deeply concerned about the proposed Quartz Hill Molybdenum Mine within the Misty Fjords National Monument. This enormous proposed open pit mine could have devastating environmental impacts upon the Monument. We understand that the single most important environmental issue may be where to place the tailings after mining. We also understand that the U.S. Environmental Protection Agency opposes placing these tailings in Wilson Arm, a spectacular fjord that supports one of Southeast Alaska's most important salmon runs. The problem is that Wilson Arm may not be big enough to contain all of the tailings. Surface waters could be contaminated and salmon runs seriously degraded. The EPA prefers the far larger and less productive Boca de Quadra Fjord for tailings disposal.

We agree with EPA that the salmon runs and other natural resources of this magnificent area need maximum protection, and that no tailings disposal should take place unless in the environmentally preferred area. For this reason we support the Boca de Quadra Basin tailings disposal alternative and urge the Forest Service to adopt this environmentally preferred alternative in its Final EIS on the project.

. . . To explore, enjoy and preserve the nation's forests, waters, wildlife, and wilderness . .

-2-

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Please keep us informed.

Ron Guenther
Conservation Chair
For the Sierra Club - Redwood Chapter

Copies to: Chapter Secretary

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KETCHIKAN, AK 99901

June 23, 1987
Rt. 2, Box 250
Galesville, Wi. 54630

Edward P. Johnson
U.S Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I am writing concerning the tailings site for the meybdenum mine that the Borax Corporation will aoperate at Quarte Hill in the Misty Fjord National Monument.

The mine will produce a large amount of tailings over its years of operations. The Borax Corp. wishes to place the tailings an the Wilson Arm fjord. Hewerver, the EPA has studied the areas and has determined that the Boca de Quadra Fjord site would be much less harmful.

With the large amounts of tailings to be predwced by the mine, the EPA has determined that the Wilson Arm is too small and too productive, supporting important salmon runs. The tailings would probably become requspended and the waters of the area contaminated by them. The Boca de Quadra fjord, however, is large and would probably prove to be less destructive.

I hope that the Forest Service will give more consideration to the Boca de Quadra site in view of the potential destructiveness to the tailings being deposited at the Wilson Arm site.

Sincerely,

Dianna M. Brown

Dianna M. Brown

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TONGASS N
KETCHIKAN, AK 9

110 Oxford
Irvine, Ca 97215

June 23, 1987

Mr. Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Good Day:

Please protect the Misty Fjords National Monument by seeing that the molybdenum mine at Quartz Hill, run by the U.S. Borax Corporation, is permitted to dump its tailings only into Boca de Quadra basin, and not into Wilson Arm.

Wilson Arm is not large enough to contain the tailings that will be generated at the rate of more than 80,000 tons per day over the life of the pit mine, which is expected to be over 50 years. And further complicating the issue, this fjord supports one of southeastern Alaska's best salmon runs.

This fishery, a sustainable resource, should take priority over the mine, which is an exhaustible enterprise. In the long term, the continued health of the resource base must outweigh the short-term profit sheet of U.S. Borax.

Thanking you for considering my views, I remain,

Larkette

(Ms.) Larkette Lein

194

Bechtel, Inc.
Engineers — Constructors

Fifty Beale Street
San Francisco, California
Mail Address: P O Box 3965, San Francisco, CA 94119

June 23, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

This letter responds to the Forest Service's request for comments on the Revised Draft Environmental Impact Statement (RDEIS) for the Quartz Hill Molybdenum Project.

During the period January 1982 to July 1984, Bechtel and the United States Borax and Chemical Corporation (U.S. Borax) conducted a feasibility evaluation of the Quartz Hill Molybdenum Project. During this evaluation, Bechtel assisted U.S. Borax in formulating a functional plan of development after a thorough examination of several alternative concepts. Each alternative was evaluated for its environmental impact, technical feasibility, and cost effectiveness. Bechtel also managed the construction of the 10-mile long bulk sampling access road. Because of this involvement, we are familiar with the unique geographic, climatological, and logistics characteristics of the site as well as the special requirements for environmental protection under the Alaska National Interest Lands Conservation Act.

Based on our knowledge of the project, Bechtel believes that this world-class mineral resource can be developed in a manner that balances environmental and economic values, consistent with national and State of Alaska interests. The Forest Service's Preferred Alternative generally represents an equitable balancing of such values. In particular, our studies support the Forest Service's preference for tailings disposal in Wilson Arm-Smeaton Bay. The Wilson Arm-Smeaton Bay disposal has clearcut advantages in that it will confine environmental impacts to a single drainage and will avoid impacts to Wilderness Area values.

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As part of the feasibility evaluation, Bechtel also investigated several alternative water supply sources to meet project water requirements. One alternative considered was construction of a large dam (more than 100 feet high) on Tunnel Creek to supply water requirements during Phase I and II. This scheme, with the addition of a Blossom River emergency backup supply, is incorporated into the Forest Service's Preferred Alternative. Another alternative considered was construction of an approximately 50-foot high dam at Tunnel Creek, with a supplementary supply on the Wilson or Blossom River. We recommend incorporation of this latter scheme into the Preferred Alternative because it: 1) could be inherently more reliable than the Tunnel-Creek-only scheme, and 2) would protect fishery resources through maintenance of in-stream flow release.

#1

In conclusion, we acknowledge the considerable effort expended by the Forest Service in evaluating this important project and appreciate this opportunity to comment.

Very truly yours,

RC Johnston

R. C. Johnstone, Jr.
Vice President and Manager
Mining and Metals Operation

195 June 23, 1987

Re: Misty Fjords - Quartz Hill Plan

My husband & I are opposed to allowing a mine operation by US Borax Corp. in the heart of the Misty Fjords National Monument. However, if the project does commence, please see that the tailings would be disposed where it would do the least ecological/environmental harm - not in beautiful Wilson Arm to disturb the Salmon. Boca de Quadra would be better. Thank you - sincerely - JG Hansen

Robinson and Hansen
3625 North Palo Alto
Panama City, FL 32405

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KETCHIKAN, AK 99901

Edward P. Johnson
U.S. Forest Service
Federal Bldg
Ketchikan, Alaska 99901

196 June 24, 1987

Dear Mr. Johnson,

We write to urge you not to allow the U.S. Borax Corp. to dump their tailings from the molybdenum mine at Quartz Hill in Wilson Arm. The Boca de Quadra basin is environmentally preferable and should be used instead. Thank you.

George Cooper
[illegible]
803 Lake Pt. Dr.
Ft. Ldle. Fl. 33309

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1987

Edward P. Johnson
U.S ~~Forest~~ Service
Federal Bldg.
Ketchikan, Alaska 99901

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Resource Development Council for Alaska, Inc.

807 "G" Street, Suite 200, Anchorage, Alaska 99501-3448
Box 100516, Anchorage, Alaska 99510-0516 – 907/278-9700

June 24, 1987

Mr. Win Green, Forest Supervisor
U.S. Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Ak. 99901

Dear Mr. Green:

In preparing its reply to the Quartz Hill Revised Draft Environmental Impact Statement (RDEIS), the Resource Development Council formed a special study team to review and comment on the document. The team featured a wide spectrum expertise, including geologists, marine biologists, hydrologists, engineers and recreation professionals. Based on the study team's review, **the Council supports the U.S. Forest Service preferred alternative for tailings disposal.** With proper care, the Council believes there will be no significant difference in the environmental effects of tailings disposal in Wilson Arm as compared to Boca de Quadra.

RDC views the Quartz Hill molybdenum deposit as a vast untapped source of mineral wealth, important to national security, Alaska's economic well being and the long term competitive position of the U.S. in the international minerals market. The state's social and economic progress will be largely dependent on projects aimed at developing its massive mineral wealth. Quartz Hill will employ thousands of Alaskans and provide tax revenues to both Ketchikan and the state.

However, Quartz Hill can only become a reality and benefit the people of Alaska if it is competitive and among the lowest cost producers. It is this need to develop Quartz Hill into a lost-cost competitive producer which is so necessary for its economic viability. As a result, the manner in which U.S. Borax will be allowed to develop the project will have a profound effect on its cost structure and potential profitability. It is vital that the permitting agencies recognize the important environmental and socio-economic benefits to be gained through timely, efficient development of this project.

The controllable cost alternatives in the RDEIS that will have major influence on the ability of Quartz Hill to be cost competitive are:

- **Disposal of tailings into Wilson Arm/Smeaton Bay**
- **A low-cost reliable source of water**
- **A low-cost source of electric power**

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Tailings Disposal

The Environmental Protection Agency (EPA) preferred alternative for tailings disposal is based on the premise that a deeper fjord will provide increased protection from possible acute copper toxicity and other environmental impacts. However, the data used to arrive at this conclusion are based on very conservative or "worst case" assumptions.

As administrator of the Misty Fjords National Monument and lead agency in the environmental process, the U.S. Forest Service has the responsibility to consider all of the impacts and strike a balance between environmental, economic, social, monument and wilderness values. In processing the National Pollution Discharge Elimination System (NPDES) permit required for tailings disposal, the EPA should also consider all environmental factors, not limiting itself only to marine factors.

In granting its permit, EPA's main concern should be whether a Wilson Arm discharge would cause unreasonable degradation of the marine environment. Even if some uncertainty exists, the Council urges the EPA to allow tailings disposal in Wilson Arm with a monitoring program, especially since there is no evidence that irreparable harm would occur should tailings disposal occur in Wilson Arm.

RDC supports the Forest Service preferred alternative for tailings disposal in Wilson Arm because:

- **The impacts of the mine development would be confined to a single drainage.**
- **The impacts on wilderness values would be minimized since it would not be necessary to construct facilities for tailings disposal in designated Wilderness as would be required if tailings were disposed in Boca de Quadra.**
- **The estimated "worst-case" losses to the commercial fish and shellfish for the two alternatives as reported in the RDEIS are only: Wilson Arm $7,334/annually, Boca de Quadra $5,005/annually.**
- **Wilson Arm tailings disposal would eliminate the need for a $59 million tunnel and a $1.6 million annual operating cost. These savings are equivalent to about 55 cents per pound of molybdenum produced and are a key element in the cost competitiveness of the project.**
- **There is no discernable economic or other advantage that would justify the additional cost of the Boca de Quadra alternative.**
- **Disposal into Wilson Arm may even have a positive effect to the marine environment by generating more productive areas.**

The Council believes it is unwise to trade all the advantages associated with using Wilson Arm for tailings disposal for the very

marginal, if measurable benefits, afforded by the deeper waters of Boca de Quadra. There is adequate capacity in Wilson Arm for the tailings. At the end of the 55-year mine life, the top of the tailings would be 150 feet below the top of the outermost sill in Smeaton Bay and 580 feet below the water surface.

In the RDEIS, the Forest Service says that with appropriate mitigation, there is little difference in the environmental effects of tailings disposal between the Wilson Arm and Boca de Quadra; including the effects on anadromous fish, other food fish and fish habitat. RDC agrees with the Forest Service and so do some of the world's foremost experts. On the other hand, the increased environmental impacts of the Boca de Quadra alternative in areas other than marine effects, are considerable.

Disposal in Boca de Quadra at EPA's location would require a tunnel through 7.25-miles of mountains. In addition, Boca de Quadra disposal would spread the impacts to a second drainage basin of about 18 square miles, most of which is in the national monument wilderness. Using Wilson Arm also eliminates the need to construct tailings disposal facilities in the wilderness at the Boca de Quadra tunnel portal. These would occupy about 25 acres, stretching from tidewater to an elevation of about 100 feet.

Boca de Quadra is a classic fjord feature which should remain entact for public enjoyment. Mitigating measures to preserve this geologic object from mine tailings should be pursued in Wilson Arm, a fjord of less significance. Section 503 (c) of ANILCA directs protection of objects with ecological, cultural, geological, historical, prehistorical and scientific interest. The only object having all these interests is Boca de Quadra.

But most far reaching are the socioeconomic advantages of using Wilson Arm. The capital cost difference between tailings disposal in Wilson Arm and in Boca de Quadra is approximately $59 million, plus increased costs for pumping and other operations of $1.6 million annually. These costs taken together are equivalent to increasing the annual payroll cost by 50 percent. The result of adding such a cost burden would be to delay the start of the project, and once started, it would drain the economic strength needed to operate through the molybdenum price dips of the future.

If the operator is forced to "overbuild" this project at excess cost through the development of unnecessary environmental protections, the overall losers will be the nearby communities, the State of Alaska and eventually the post-mine users of the project area. If this project is forced to become a "marginal" venture, opening and closing at the whim of world metals prices, then we can expect extended mine life and potentially drastic social, economic and personal impacts on local communities and the entire region. Any EIS process dealing with this project must take these factors into consideration. The EPA's Draft Best Professional Judgement Report is deficient in this regard.

In its arguments for selecting Boca de Quadra, EPA raises a possibility of acutely toxic levels of copper in the discharge. EPA's basis for this are "worst case" assumptions for both the levels of dissolved copper in the effluent and for the value representing the threshold level for acute toxicity. The tailings are very similar to the rock flour from glacial action which reaches the fjords every summer. The pilot plant testing on bulk ore samples showed that the copper levels in the tailings at the end of the pipeline will be below EPA's requirements.

EPA has not shown there are any adverse effects from minor amounts of fines which might escape into Behm Canal. National Marine Fisheries has considered this and has given an opinion that this "would not likely result in a discernible impact to the fishery resources of Behm Canal."

Regarding EPA's concerns about the environmental effects of the tailings deposited in Wilson Arm eventually rising to above the 100 meter depth at the outfall, the risks of this happening are not apparent, but if it is regarded as a problem, it can be avoided by moving the outfall down the fjord. Any suspected impacts are long term and will be seen long in advance. Permits can provide for mitigation and there would be ample time to put mitigating measures into effect.

#1

The Resource Development Council rejects the conclusion stated throughout the RDEIS that all actions in the Quartz Hill project area should be designed to minimize all human impacts. In fact, the goal of the permitting agencies should be to minimize negative impacts of the project while recognizing the opportunity to derive public benefits from the project's operation.

The legislative history of this project is relatively straightforward. Congress made a positive decision to remove Quartz Hill from the Wilderness area that had been created by ANILCA. The non-Wilderness enclave was specifically excluded from the provisions of the Wilderness Preservation Act. Attempts by permitting agencies to require compliance with the Wilderness Act or other non-statutory wilderness goals are inappropriate and misguided. Congress was quite clear on this issue--the project area was set up to allow the reasonable development of the Quartz Hill molybdenum deposit.

In light of the specific non-Wilderness designation of the project area, we feel it is appropriate for the Forest Service, as lead agency, to review a wider range of goals and opportunities for land use and management in the project area. The often explicit, but always implicit, goal of returning the Quartz Hill area to a state as similar to "wilderness" as possible is only one option. We propose a slightly different perspective on this issue, especially as it impacts tailings disposal.

Generating Productive Marine Environments

#2

Instead of viewing the tailings disposal quandary as a problem and trying to minimize any and all impacts of its eventual siting, we

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suggest that the relevant agencies view this as an opportunity to generate more productive environments in and adjacent to the project area. The RDEIS goes to great length discussing the relatively low habitat values of the vey deep, benthic habitats present in both disposal location alternatives. By contrast the relatively limited estuarine habitat in both Smeaton Bay and Boca de Quadra are praised for their productivity and importance to the fisheries resource.

By disposing tailings in the shallower Wilson Arm area, more productive estuarine-type habitat would be created, resulting in an increase of productivity. Through careful monitoring of the tailings disposition and potential relocation of the outfall further up Wilson Arm, the tailings can be deposited in a manner that will increase the variety of habitats in the region and increase the value of Smeaton Bay to the overall ecology.

#2 Cont.

Since legislation requires that environmental resources be protected, perhaps the best way to protect those resources is to develop a program that enhances environmental values that are currently limited in Southeast Alaska.

Many habitat values have already been identified in the RDEIS. These include waterfowl habitat, estuarine habitat, nursery grounds for juvenile salmon habitat, shallow water benthic habitat, and salmon enhancement. The base line studies have already shown that primary production is greatest in waters less than 25 meters deep. Invertebrate species richness and productivity is highest in shallow water habitat. Crab and shrimp are also most abundant at shallow and mid-depths.

It would appear that with the disposal of tailings in Wilson Arm, a significant enhancement could be made within that fjord by increasing the amount of shallow water habitat. Mother Nature is already filling in the fjord with sediments that have created the productive habitat at the mouth of the Wilson River. Such habitat could be substantially increased during the mine life with a specific enhancement program that targets development of shallow water habitat.

Boca de Quadra is too deep to take advantage of this opportunity. It would require the deposition of many times more material than is available to make a similarly positive impact on that water body. Instead, it seems possible to maintain wilderness opportunities in Boca de Quadra if no tunnel of outfall facility is required in the entire drainage.

In other areas of the world, people are trying to increase the productivity of marine environments by doing exactly what the EPA is trying to prevent. In most cases these enhancement projects are not economically feasible because the necessary supply of fill material is not immediately at hand. Such a supply is at hand for Wilson Arm.

The selection of the Wilson Arm tailings disposal site would be a positive step toward a cost-competitive Quartz Hill

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operation. Such an operation could bring thousands of new jobs to Alaska and annual benefits of $72 million to the state's economy. This is of particular importance in Alaska's attempts to diversify its economy.

In addition, Quartz Hill can diversify and strengthen the Southeast Alaska economy through the purchase of goods and services for construction and operation of the project. Quartz Hill would also contribute to the national balance of payments, increase and stabilize the economy of Alaska by broadening its industrial base and strengthen Alaska's trade balance and economy by making the state a dependable source of molybdenum for domestic and international markets.

Water Supply

In the interests of permitting a strong project, the Council would also like to comment on water supply. The Forest Service prefers to capture all of the process water during phase I of operations from a 110 foot high dam in the Tunnel Creek Valley. This would be supplemented only when the plant is expanded in phase II from a secondary source near the mouth of the Blossom River.

Such a plan has two major problems: cost and reliability. This plan would cost $30 million more than a proposal by Borax to build a dam that is only half as high and supplement it during phase I with wells near the Wilson River. The water from the wells may never be required and would only be used in the unlikely event that there was not sufficient surface runoff during isolated periods.

#3

The Borax plan provides the company with the added reliability of a supplemental water source during phase I. This would reduce the risk of plant shut downs during dry periods. We believe it is imperative that the Blossom River secondary water source be made available during phase I. Such action would reduce costs and improve project stability while resulting in no significant adverse impacts to the environment.

Electric Power

The Resource Development Council agrees with the Forest Service in that electric power should be generated on site since off-site generated power is not available. Although it is not essential to the Quartz Hill project, the proposed Southeast Intertie would lower capital and operating costs of the project. However, imported British Columbia power is not part of the project concept.

It is in the best interest of the permitting agencies to make sure that the Quartz Hill project is allowed to be commercially viable so that the ore deposit can be fully exploited in a reasonable and timely period and in a cost effective and competitive manner. It

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is also in the best interests of the affected communities to see the project become consistent and predictable source of employment and tax revenues.

Sincerely,

RESOURCE DEVELOPMENT COUNCIL
for Alaska, Inc.

Becky Gay

Becky L. Gay
Executive Director

cc: Governor Steve Cowper
Senator Ted Stevens
Senator Frank Murkowski
Congressman Don Young
Representative John Sund
Senator Lloyd Jones
Representative Robin Taylor
Eugene Smith, U.S. Borax
Diane Meyer, Division of Governmental Coordination
Robert S. Burd, U.S. Environmental Protection Agency
Colonel Wilbur Gregory, U.S. Army Corps of Engineers

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RECEIVED
KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

June 24, 1987

Ed Johnson
U.S. Forest Service
FEderal Building
KEtchikan, AK 99901

DEar Mr. Johnson:

I am writing to express my concern over Borax's mining project in our Misty Fjords National Monument. I am strongly opposed to the project and find it incomprehensible that Borax may be allowed to dump tailing into the Wilson Arm, an area worth millions of dollars for its salmon fishery. Protection and preservation of this area, which supports one of Southeast Alaska's most important fisheries, should be of utmost concern to all of us.

If the project must continue, please see that tailings are dumped in a less sensitive area.

Thank you.

Sincerely,

Sondra Stanway

Sondra Stanway
115 Enos Street
Juneau, AK 99801

cc: Governor Steve Cowper
Robert Burd
Col. Wilbur Gregory

199

1115 E. North St.
Algona, Iowa 50511
June 24, 1987

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

To Mr Johnson:

Concerning the molybdenum mine at Quartz Hill in Misty Fjords National Monument:

I oppose the Forest Service plan to place tailings in Wilson Arm.

I support the EPA idea to put the tailings in Boca de Quadra fjord.

Thank you for your consideration,

Dennis Halley

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KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

200

MS OLGA ROSCHE
[illegible]

June 24, 1987

Mr. Edward P. Johnson
U.S. Forest Service
Federal Bldg
Ketchikan, Alaska 99901

RECEIVED
KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 9[illegible]

Dear Mr. Johnson,

The molybdenum mine at Quartz Hill in Misty Fjords Nat'l. Monument in Alaska and its problems have come to my attention. I'd like you to know that I am in favor of opposing the depositions of the tailings from the mining process in Wilson Arm, a beautiful spot and a place where southeast Alaska has a very important salmon run. Why ruin yet another place in Alaska to benefit the U.S. Borax Corp? I just bristle when I think about the many lumber, mining, grazing, etc. companies who rape and plunder our natural resources to give more welfare to the wealthy.

"I've never been to Alaska, and I don't want it trashed before I get there," says one volunteer on the "[illegible] development in Alaska." Thank you for considering my views.

Very truly yours,
Mrs. [illegible] Rosche

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Paul Berry
Post Office box 143
Gustavus, Alaska 99826

June 24th, 1987

RECEIVED
KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:
I would just like to say as a resident of Southeast Alaska that I am disturbed by the plan of U.S. Borax to dig a huge pit within Misty Fjords National Monument. I believe the long term losses in fishing, recreation, and tourism in the area would be far greater than any eventual gain our region would recieve in mining-jobs and mining-money. It's just not worth destroying more wilderness for the benefit of another environmentaly damaging industry in Southeast Alaska

Thankyou for your time,
Paul Berry
Paul Berry

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KETCHIKAN AREA
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TONGASS NF
KETCHIKAN, AK 99901

June 25, 1987

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I am writing concerning the Environmental Impact Statement developed for the U.S. Borax operation within Misty Fjords National Monument. During the preliminary site investigation I was working for the U.S. Geological Survey on monitoring water flow and water quality on the Blossom, Wilson, and Keta Rivers. Since that time I have worked for the Alaska Department of Fish and Game on site invesigations for the Susitna Dam project. I have submitted written coments during the public comment period for the draft EIS on U.S. Borax operations. I would like to take this opportunity to repeat my previous comments.

I support the position that the U.S. Enviornmental Protection Agency has taken in regard to mine tailings disposal. The valuable fisheries that depend on the Blossom and Keta River system must be a priority. The disposal of mine tailings in the middle basin of Boca de Quadra will insure that the fishery is best protected from mining activities. An increase in the amount of tailings may occur during the life of the mine due to more efficient mining techniques. Because of previous acceptance of the middle basin disposal site by local fisheries unions and the EPA, the acceptance of increased tailings by regulatory agencies would be streamlined.

#1 The Forest Service should not support a well field in the upper reach of the Wilson River until groundwater studies show that there will not be a draw-down of river flow, especially during winter low flow periods. Salmon egg beds are dependent upon upwelling of groundwater to insure that eggs are not frozen or dehydrated. The Wilson River supports a large fishery that is important for long term economic returns to the fishing industry.

The Forest Service should also oppose any weir or low dam system on the Blossom River. The upper reaches of the Blossom River provide excellent fish rearing habitat. Impeding the movement of fish or altering the rearing capacity of this river would have a adverse impact on the fishery.

I believe that the mining operation and the fishing industry can coexist. However, I feel that the Forest Service should place more emphasis on protecting the fishery resource. U.S. Borax stands to make millions on

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the public resource. This area of Misty Fjords will never look the same after the mining is finished. One has only to look to the mountains of Colorado to see the changes that molybdenum mining has brought to the Leadville area. Right now we have a world class fishery in Misty Fjords because of the productive areas of the Wilson, Blossom and Keta Rivers. These Rivers will provide a lasting return to the economy of Ketchikan with little input to or destruction of the publics' resources.

Thank you for allowing me to comment.

Sincerely,

Chris S. Tomich Kent

Chris S. Tomich Kent
P.O. Box 20571
Juneau, Alaska 99802

203

June 25, 1987

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

RE: Quartz Hill molybdenum mine
Misty Fjords National Monument
(revised draft E.I.S.)

Dear Mr. Johnson:

I am amazed and disappointed that the Forest Service is agreeable to the development of a large, open pit mine in the center of a National Monument. Designation as a National Monument in itself should be reason enough to prohibit such an operation in this particular area. As a hiker, naturalist, and would-be visitor to Alaska--I am especially outraged at the prospect of U.S. Borax being allowed to dump tailings from the mine in the Wilson Arm fjord. With over 80,000 tons of tailings being generated each day for years to come, the fjord as we know it today would be destroyed.

Alaska is this nation's last opportunity to do something right for future generations. Hopefully, the U.S. Forest Service can be convinced that long range protection of its fragile ecosystems far outweigha any benefits that might be derived from commercial endeavors.

Please add this letter to the public record on this matter. When a decision has been reached, I would like to be advised as to the details of that decision. Thank you.

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KETCHIKAN, AK 99901

Sincerely,

Diane Hankins

Diane B. Hankins

2407 Slay Dr.
Greenville, NC 27858

204

June 25, 1987

Mr. Ed Johnson -

I am disturbed to learn of U.S. Borax's (why is it called "U.S." Borax if it is owned by a British conglomerate ?) proposed operation in Misty Fjords National Monument (and why is it called a "National Monument" if it is treated like a piece of privately owned land?) The thought of the potential destruction to the area - especially the Wilson Arm - makes me exceedingly angry.

If the operation does in fact start mining, I am urging you to prevent them from dumping the tailings in Wilson Arm, and direct them to use the middle basin of Boca de Quadra. Which is more important: that U.S. Borax make more money or that an area that has existed for millenia, and used by generations of people be spared?

Does the public have any say at all?

Respectfully,

Dan Morington
Sitka, Alaska

205

KETCHIKAN COMMUNITY COLLEGE

7th and Madison
KETCHIKAN, ALASKA 99901-5798
907-225-6177

June 25, 1987

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JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

Win Green, Forest Supervisor
U. S. Forest Service
Federal Building
Ketchikan, AK 99901

Re: Quartz Hill Molybdenum Project Mine Development--
Environmental Impact Statement

Dear Mr. Green:

I am writing in support of the U.S. Borax Quartz Hill Molybdenum Mine Project.

I am in support of the total project and in particular the disposal of tailings into Wilson Arm. This particular alternative is desirable for several reasons:

1. It is more economically sound to dispose in Wilson Arm for the U.S. Borax Co. That is of great importance in the international economic competition.

2. From reading the three-volume report, I can find no significant difference on the environmental impact between Wilson Arm and Boca de Quadra disposal sites.

3. Wilson Arm is not in the National Monument.

4. It just makes more sense to keep as much activity as possible in the Wilson Arm area rather than spreading it over into Boca de Quadra.

I have known U.S. Borax Company for over 40 years. I know them to be a responsible world class organization. I believe that they will develop the mine in an environmentally responsible manner.

I urge your approval of the project with disposal in Wilson Arm.

Sincerely,

John C. Menzie

JOHN C. MENZIE
Campus President

JCM:mdw

A Campus of the UNIVERSITY OF ALASKA Statewide System

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Southeast Alaska Conservation Council

SEACC • P.O. Box 021692 • Juneau, Alaska 99802 • (907-586-6942)

June 26, 1987

Mr. Ed Johnson
U.S. Forest Service
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Ed:

The following comments concerning the U.S. Borax Quartz Hill Proposed Project are submitted on behalf of the Southeast Alaska Conservation Council.

First off, we would like to go on record in full support of the comments submitted to you by the Southeast Alaska Seiners. We think their statements were comprehensive and straightforward. We urge that you give their comments complete consideration. Furthermore we support the comments submitted to you by the Alaska Trollers Association.

Q-164

Secondly, we would like to fully endorse the comments submitted to you by the National Marine Fisheries Service. We strongly support their position which backs up the Environmental Protection Agency's preferred action of dumping the tailings into the Middle Basin of Boca de Quadra.

Third, SEACC's specific position is as follows:

1) If tailings must be dumped, SEACC supports the EPA's position to dump them in the Middle Basin of Boca de Quadra.

2) We are opposed to any and all proposals for a well field in the Wilson River drainage. We support the S.E. Seiners position that no water should be taken out of the river, and no road should be built along or near it. This would prevent damage to the largest pink salmon producing river in Alaska.

3) The Blossom River is also a very high salmon producer. We are opposed to draining supplemental water from the Blossom River and/or the construction of a weir/low dam system that would impede fish movement.

1

4) SEACC feels that the Forest Service needs to do further studies concerning the dumping of tailings on land-based sites, and the possibility of closing and rehabilitating the existing road to the Wilson Arm. We also feel that the agency needs to recommend the inclusion of "non-wilderness" monument lands, that will not be impacted by the approved project, back into the Misty Fjords Wilderness. Congress excluded much more land from wilderness than was needed for the project, and the Forest Service should examine this matter in detail. Your agency should examine including the Wilson, Blossom and Keta Rivers in this review.

2

JUNEAU GROUP SIERRA CLUB, Juneau • LYNN CANAL CONSERVATION, Haines • SITKA CONSERVATION SOCIETY
ALASKA SOCIETY OF AMERICAN FOREST DWELLERS, Point Baker • FRIENDS OF BERNERS BAY, Juneau • PELICAN FORESTRY COUNCIL
NARROWS CONSERVATION COALITION, Petersburg • FRIENDS OF GLACIER BAY, Gustavus • TONGASS CONSERVATION SOCIETY, Ketchikan
FALSE ISLAND-KOOK LAKE COUNCIL, Tenakee Springs • WRANGELL RESOURCE COUNCIL • TAKU CONSERVATION SOCIETY, Juneau

5) Page xvii of the EIS requests further information on our concerns regarding the impacts associated with the Boca de Quadra -- especially in relation to wilderness and socio-economics. SEACC has the following comments:

3

--Wilderness -- The project will have a heavy impact on existing wilderness values. Borax's concerns that the Boca de Quadra alternative will impact the wilderness are certainly not genuine. SEACC believes in wilderness designation as a positive land use classification. However, we are not blind ideologues. In this situation where the Borax project will do so much damage anyway, we feel that the loss of "wilderness values" by selection of the Boca de Quadra (Middle Basin) alternative would be an acceptable impact on a minor portion of the wilderness.

In other words, we feel that dumping the tailings into the Middle Basin of Boca de Quadra is overall a more environmentally sound alternative. It makes the best long term sense to construct the facility there, within the wilderness near Boca de Quadra. This would serve to prevent the risk of impacting the very valuable fishery resources in the Wilson Arm area.

Your own report (pg.4-254) recognizes that this proposal would result in very limited, highly localized, and insignificant overall impacts. To us, the visual intrusion would be worth it, in order to protect the Wilson Arm area. (In your own agency's jargon, it would be a "trade-off" that we could live with.)

4

--Socio-Economics-- We think that the S.E. Seiners made some excellent points in their letter regarding this issue. It is our feeling that if Borax will profit from mining a public resource, that they must honor public concerns. SEACC believes that Borax has bullied the Forest Service, the State of Alaska, and the people of Alaska and the United States for long enough. They should be forced to agree to dump their tailings in the Middle Basin of Boca de Quadra. This would respond to socio-economic concerns that go beyond Borax's pocketbook and their own self-interest. When Don Finney was confronted with the possibility of being forced to proceed under the "more costly" EPA alternative of dumping in the Middle Basin of Boca de Quadra, he said the following: " The acceptance of that proposal would mean just one more delay. But whatever happens, the project will go on. It's too big not to."

It is SEACC's view that Borax has gotten what it wanted every step of the way along the road of gaining approval of this mine project. We believe that the Forest Service needs to buck up and stand firm against the enormous pressure being exerted by Borax's public relations campaign. Now is the time for the agency to support the EPA's position that the tailings should be dumped in the Middle Basin of Boca de Quadra. Such a stance will be in the best long term interest of the public's resources and the citizens of the United States.

Thank you for the opportunity to comment on this important matter.

Sincerely,

Bart

Bart Koehler
Executive Director

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RECEIVED
KETCHIKAN AREA
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TONGASS NF
KETCHIKAN, AK 99901

2051 Sea Level Drive #303
Ketchikan, AK 99901
June 26, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I am definitely concerned with the economic future of Alaska, not only for myself, but more especially for my children and granchildren, and naturally, for all the residents of this state. We need this molybdenum mine to be put into operation as soon as possible with reasonable environmental controls.

Surely the environmentalists can understand the need for this industry since their economic future is governed by the same needs as everyone else in this state.

Sincerely,

Mrs. Ruth Stump
Mrs Ruth Stump
cc: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

208

PACIFIC LEGAL FOUNDATION

COMMENTS ON THE
QUARTZ HILL MOLYBDENUM
PROJECT MINE DEVELOPMENT
REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

RECEIVED
KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

June 26, 1987

RONALD A. ZUMBRUN
ROBIN L. RIVETT
Pacific Legal Foundation
555 Capitol Mall, Suite 350
Sacramento, CA 95814
Telephone: (916) 444-0154

JAMES S. BURLING
Pacific Legal Foundation
807 G Street, Suite 200
Anchorage, AK 99501
Telephone: (907) 278-1731

Attorneys for Pacific
Legal Foundation

INTRODUCTION

Pacific Legal Foundation is a nonprofit public interest law firm based in Sacramento, California, with a branch office in Anchorage, Alaska. PLF has over 19,000 supporters throughout the United States and has the primary purpose of litigating in the public interest and in defense of individual freedoms, private property rights, and the free enterprise system. PLF has extensive experience in the field of natural resource and environmental law and the issues surrounding natural resource development. Because the development of valuable mineral deposits is of great import to Alaska's mining industry, and the resource security of the United States, PLF is making these comments to encourage the appropriate federal agencies to ensure that the project is allowed to proceed without any unnecessary burdens and in accordance with all applicable environmental rules and regulations.

COMMENTS

In general, the revised draft environmental impact statement (RDEIS) on the Quartz Hill Molybdenum Project is well put together and complies with the letter and intent behind the National Environmental Policy Act and the Alaska National Interest Lands Conservation Act. It is an extremely comprehensive document and reflects careful analysis of all relevant environmental issues and is presented in a format which is useful to the public.

These comments concern whether the Quartz Hill Molybdenum Project should be permitted to dispose of tailings in

Boca de Quadra or Wilson Arm. From a careful examination of all relevant data and statutory law it is plain that Wilson Arm is the appropriate alternative.

As a useful touchstone to this discussion, reference is made to the intent of Congress when it recently revised the Clean Water Act. Section 308(e)(2) of those revisions states that the administrator may issue a permit when there is "no reasonable relationship between the economic and social costs and the benefits to be obtained ... from achieving such limitation." (To be codified at 33 U.S.C. § 1312.)

While this revision is not directed towards the decision of where the Quartz Hill tailings should be placed, it does show that Congress clearly envisions that a reasonable balance should be drawn between the protection of the environment and the economic and social costs that will result from such protection of the environment.

#1

In the case of tailings disposal for the Quartz Hill Molybdenum Project, the suggestion by the Environmental Protection Agency (EPA) that tailings should be disposed of in Boca de Quadra is clearly unwarranted because any hypothetical environmental benefit will first of all be outweighed by the obvious environmental consequences of extending operations into a new drainage. Second, any so-called benefits from the Boca de Quadra disposal plan will be far outweighed by the tremendous costs of this alternative. These costs could foreclose any possibility of development of the deposit to the economic and social detriment of people of southeast Alaska and to the

#2

detriment of all citizens of the United States dependent on a stable supply of strategic minerals and a more favorable balance of payments.

EPA appears to have completely ignored the social and economic consequences of its proposed Boca de Quadra tailings disposal alternative. In a word, therefore, EPA's analysis and recommendation of the Boca de Quadra alternative is flawed. #3

EPA bases its recommendation for Boca de Quadra tailings disposal on its "best professional judgment" conclusion that the environment of Wilson Arm might be adversely affected. This conclusion, however, relies on a series of assumptions and extrapolations about tailings disposal. It is clear, however, that there is no conclusive evidence that Wilson Arm disposal would have any adverse effects. Instead, EPA's preference for Boca de Quadra is based on an untested assumption that because Boca de Quadra is deeper than Wilson Arm the tailings might have less of an environmental effect. The problem with this analysis is that it proves nothing about any adverse effect on the environment.

Although EPA is willing to base its Boca de Quadra preference on untested hypotheses, it is not giving equal consideration to the environmental benefits that may occur from Wilson Arm disposal. As stated in the Best Professional Judgment Report (Draft) (BPJR draft) at 94 because Wilson Arm would change from a fjord to a relatively shallow bay, tailings disposal in Wilson Arm "could potentially enhance productivity of this bay." This consideration deserves at least equal weight

with the "potential" and equally unproven adverse effects cited as a reason against Wilson Arm disposal.

#4 EPA raises some concern over the consistency of a Wilson Arm disposal alternative with the coastal management program. However, as stated in the last paragraph, it does not give adequate consideration to the possibility that this alternative could enhance coastal habitats and increase productivity after the cessation of mining.

Furthermore, the discussion of "significant public need" for the project is too cursory, being dismissed on Page No. 112 of the BPJR draft because U.S. Borax did not describe the need for the mine project. This is to ignore the obvious. The draft environmental impact statements and project descriptions are replete with references to the tremendous employment opportunities to be made available to southeast Alaska from the project. Likewise, the public benefits that will flow from a new domestic source of a strategic mineral and the potential for an improved balance of trade cannot be easily ignored.

#5 EPA has chosen not to consider the economic and social benefits that will flow from the development of the project nor the potential harm the Boca de Quadra alternative will have on the chances that the project will be completed in first place. While EPA's primary function is to analyze the biological effects from the project alternatives, it gives short shrift to consideration of effects on the "human environment" to ignore such positive benefits. Before making any decision favoring one

disposal site over another, EPA should look at the broader perspective rather than base its decision on an unnecessarily narrow consideration of unproven worst case assumptions about the effects of tailings disposal in Wilson Arm.

In addition, EPA is too narrowly considering even the biological effects of tailings disposal by not giving serious consideration to the impact on wilderness by the Boca de Quadra development into an undeveloped drainage that is for the most part surrounded by wilderness. This is not a balanced approach when a more economical alternative is available and when there is no hard evidence that the Wilson Arm alternative will have any deleterious effect on the environment.

#6

In conclusion, it is urged that EPA reconsider its preference for the Boca de Quadra alternative in light of the paucity of evidence against a Wilson Arm alternative, and the significant biological, social, and economic benefits that could result from the Wilson Arm alternative.

DATED: June 26, 1987.

Respectfully submitted,

RONALD A. ZUMBRUN
ROBIN L. RIVETT
JAMES S. BURLING

By James S. Burling
JAMES S. BURLING

Attorneys for Pacific
Legal Foundation

RECEIVED
KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

1639 Water Street
Ketchikan, AK 99901
June 26, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U.S. Dept of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

I am very much in favor of the molybdenum mine at Quartz Hill becoming a working reality, in a manner that is reasonable for the Borax Company to operate and in a safe, enviornmental way that is not detrimental to the fishing industry. From information I have been exposed to, I feel confident that Borax is prepared to give due consideration to mining and disposing of the tailings in a safe operation.

This mine can be a major economic help to our community as well as to the state of Alaska, and all residents, whether enviornmentalists, conservationalists or reasonable people who appreciate industries that are concerned about the enviornment they work in will be the benefactors of having this mine operational.

Sincerely,

Audrey Gilbert

Mrs. Audrey Gilbert
42 year resident of Ketchikan

cc: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

6-26-87

210

Dear Win Green,
I can't say it any better so I've copied this editorial.
I've supported the idea of the mine since the public hearings first started in Ketchikan. We need the economical boost. Tourism doesn't bring full time jobs for families –

Thank you,
Grace S. Micro
Box 9395
Ktn, Ak 99901

Editorial

Due soon

In two weeks the comment period ends for the draft envirnmental impact statement for U.S. Borax's Quartz Hill project. More than 100 comments have been made to the Forest Service office in Ketchikan in the month that comment has been open. All but a half dozen comments have favored the Forest Service alternative to allow tailings disposal in Wilson Arm.

The main concern in debate over the impact of the mine operation is tailings disposal in Wilson Arm may affect fisheries. So far, Borax's operation — building an access road and taking out a bulk sample of the ore — has had no effect on fisheries or fishery habitat. There won't be a negative impact on fisheries or fish habitat, according to law. It's all laid out in Section 505 (a) (b) (c) and (d) of the Alaska National Interest Lands Conservation Act of 1980.

Under terms of that section, the Secretary of Agriculture cooperates with the state to assure the mining operation is conducted without damage to fisheries or fish habitat. In the event there is damage, the secretary is required to shut down the operation for seven days, during which time he can go to U.S. District Court for an injunction stopping operations.

That's a strong stand in support of fisheries and it's the law, not just a policy or a promise.

Therefore, Borax should be allowed to go ahead with tailings disposal in Wilson Arm, as the company officials desire. They are required to do the job right or suffer the consequences, which we are sure the state Fish and Game department will cause the secretary to invoke if damage is found. The law says the state retains control over fisheries.

More important immediately is for those who favor the project to send in a letter of support. In the letter, cite a specific effect or reason why the writer believes the project should be allowed to move ahead.

After suffering the collapse of oil prices, Alaskans swore to diversify the state's economy. One way to do that is to develop the hard rock minerals in Alaska. Quartz Hill is a major part of such development and should move along promptly.

– Thanks.

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KETCHIKAN, AK 99901

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KETCHIKAN AREA
JUN 29 1987
TONGASS NF
KETCHIKAN, AK 99901

June 26, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U.S.D.A.
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green,

I am writing in support of U.S. Borax's Quartz Hill Project. I am concerned with the social and economic future of Alaska in general and Southeast Alaska in particular. I believe that the Quartz Hill Project can play an important role in the future of this state.

I understand the need to preserve the environment and to ensure the integrity or our ecosystems. I trust the need to do this will be considered in light of the economic considerations that will be a part of anv recommendation or ruling. Therefore, I would urge careful consideration of U.S. Borax's request for tailings disposal in Wilson Arm.

Thank you for your consideration of this matter.

Sincerely,

Anthony Kennedy
Assistant Superintendent

xc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

Q-170

212

27 June 1987

My thoughts on the Quartz Hill molybdenum project:

I currently earn income by deckhanding on a longline fishing boat, diving for shellfish, and salvaging beach logs for lumber and firewood. Each of these activities degrades the environment. The longlining leaves miles of lost gear in the 50-500 fathom depths of the continental shelf. Plastic bait sacks, cardboard boxes, bait box straps, pieces of buoyline, buoys, flagpoles, and other waste find their way to litter the sea bottom and shoreline. Numbers of unmarketable, but not unpalatable fish are wasted, thrown back dead or dying. I wonder what hundreds of seabirds ate before fishing boats began throwing fish scraps into the ocean.

When diving I seldom find areas with large abalone. Beds of older abalone disappear to be replaced by abalone that were sub-legal size a year or two before.

In log salvaging I find beaches littered with lost pulp and saw logs, most on their way to becoming embedded with rocks and sand, thereby useless. Pieces of styrofoam from broken up floats, Typar, fishing nets, pieces of rope, creosote piling ends, and an assortment of junked building material litters the beaches that collect drift. And while my own wood cutting may be small and isolated enough to be absorbed by the ecosystem, the results of firewood gathering by many people can certainly be seen in the wood debris and six inches of sawdust on the beach at Totem Bight.

So how can I be enthusiastic about an open pit mine in east Behm Canal? Why doesn't U.S. Borax put their money into extracting metals from junked cars instead of breaking up the continuity of a wilderness with roads, powerline interties, tailing pipes and dumps, open pits, and the noise of mining activity and its supporting logistics? Yes, I suppose there will be jobs. I sometimes wonder if a job isn't a way of avoiding the responsibility of cleaning up one's mess, of dealing with one's own garbage.

In addressing the Quartz Hill project I feel I'm confronting a machine that pays lobbyists to convince Congress there should be an open pit in a National Monument, that pays for local radio programs to give the impression its interested in the community's welfare, that pays dozens of specialists to put out volumes of Environmental Impact Statements. Its easy for me to imagine the bottom line to the machine is whether its activities keep its balance sheet in the black. If the bottom line is the dollar does the machine distinguish between selling molybdenum to make the tubing in my two-seat airplane stronger and selling molybdenum to make war planes used by Iraqis to shoot at U.S. ships? I'm interested in making my airplane, outboard motors, and chainsaws quieter and more efficient, but not by supporting someone's arms race or mideast war.

Ketchikan already has a pulp mill that apparently can't operate profitably without smelling up the air, losing logs in navigable waterways, being involved in antitrust lawsuits, or lobbying legislatures and the Forest Service to obtain the best stands of timber, shoving small logging operators off to lower grade timber and ultimately out of business.

And Ketchikan's public administrators, paid planners and consultants apparently don't have the ability to use oil wealth to purchase things that will pay their own overhead and upkeep in the long run. So my property taxes increase to pay for something purchased during the pipeline boom that isn't paying its own way now.

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TONGASS N.F.
KETCHIKAN, AK

212

I suppose merchants in Ketchikan will benefit from an increased population. More services, food, fishing tackle, outboard motors, chain saw parts, etc. will be sold. Air taxis will be able to upgrade, buy more, better planes and get less expensive parts and faster service like Anchorage has. Perhaps I'll be able to fly on Alaska Airlines from Ketchikan to Seattle as cheaply per mile as from Anchorage to Seattle. Banks will garner millions on loans to land/home buyers to develop suburbs around the lakes and grass-flats I've enjoyed hiking and hunting at.

My own education, physical and psychological tools for diminishing environmental impacts are obsolete or non-existent. I don't sit around in a cold house very long before I start up the noisy chainsaw to saw some firewood. That may not be too disagreeable when one person does it at a reasonable time of day but multiply that by hundreds of people coming to Alaska for the easy pickings of its resources and quality of life deteriates. Making someplace a National Monument is no deterrent either if its misty fjords become noisy fjords from dozens of boats and aircraft taking sightseers there. And we want the hills to reverberate with blasting and the rumble of construction equipment as well as commuting aircraft of the mine itself? In addition? I hear jets departing Ketchikan airport, and log trucks working Whipple Creek and White River drainages at Moser Bay already.

So, how is a Quartz Hill open pit going to benefit this area? How is it different from colonists temporarily moving in anywhere, extracting the resource of value and leaving? I don't hear of open pit mine sights becoming areas of high residential property value. Perhaps if a small shaft could be bored, the metal extracted from the tailings, and the tailings put back in the shaft I would be more enthusiastic about the mine's development. But an open pit and its concurrent noisy large-scale development gives me the impression the only reason its gone as far as it has is because people don't know how it will affect their lives. Perhaps they see it as a paycheck and little more.

MICHAEL SALLEE
PO BOX 7603
KETCHIKAN, AK
99901

Sincerely

Michael Sallee

213

Alaska Loggers Association, Inc.

111 STEDMAN, SUITE 200
KETCHIKAN, ALASKA 99901
Phone 907-225-6114

June 29, 1987

Mr. Win Green
Forest Supervisor
U.S. Forest Service
U.S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Win:

The Alaska Loggers Association believes that, as Alaska moves into the 21st Century, the State's social and economic progress will be dependent on projects aimed at the wise utilization of our vast natural resources — minerals as well as trees.

The Quartz Hill molybdenum deposit is a major example of Alaska's untapped reservoir of natural resources. Alaska Loggers Association supports the current development and future operation of this mining project as a stable, long-term source of jobs and revenue to the City of Ketchikan and the State of Alaska. The Quartz Hill Project can be an integral part of Alaska's future — if it is allowed to proceed in an economically secure manner.

In mining operations, as in timber operations, environmental controls must be reasonable and they must be balanced by economic considerations. Quartz Hill can benefit the people of Alaska only if it becomes a low-cost, competitive source of molybdenum. Inasmuch as U.S. Borax has determined, through extensive research and testing, that the difference in marine impacts between the tailings disposal in Wilson Arm/Smeaton Bay and Boca de Quadra will be insignificant and that the Wilson Arm/Smeaton Bay alternative has been adequately supported by data and reference material, the Alaska Loggers Association supports the disposal of tailings in Wilson Arm/Smeaton Bay.

ALA encourages the U.S. Forest Service to permit the Quartz Hill project so that both the environment and the economic competitiveness of the project receive proper and adequate attention. We are anxious to see mining, and specifically the Quartz Hill Project, join the forest products industry as an important element in the social and economic future of Southeast Alaska.

Sincerely,
Kirsten Dold
for Roger Sullivan
President
Alaska Loggers Association

SERVING ALASKA'S TIMBER INDUSTRY

USDA FOREST SERVICE KETCHIKAN AREA
RECEIVED
JUN 29 '87
FOREST SUPERVISORS OFFICE

Q-171

214

6/25/87

Dear Mr. Johnson,

I am writing to voice my objection to the U.S. Borax plan to mine in the Misty Fjords National Monument.

I feel that the evidence for adverse impact on the region is overwhelming AND that it is incredible that it appears the Forest Service is about to approve the plan.

However if you must approve the project + I dread to see the results I recommend you support EPA's position to dump the tailings (80,000 tons a day!) in the middle basin of Boca de Quadra & allow no dumping in Wilson arm.

Also I implore you to oppose any part of the project using water from or damming the Wilson or Blossom River systems.

Thankyou for considering my comments

Lesley J. Kempell
Box 34311
Juneau, AK 99803

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FOREST SUPERVISORS OFFICE	INIT	ACT.	INFO	DATE
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DFS				
PLN				
PAS				
AO				
T.M.				

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Win Green
Forest Supervisor
U.S. Forest Service
Ketchikan, Alaska

June 25, 1987

We, the undersigned, support the development of the U.S. Borax molybdenum mine in the Wilson Arm/Keta River area of the Tongass National Forest. We feel that this mine can be developed with reasonably little impact to the environment. It is important for the Country, the State, and our families that such projects be implemented in order to secure a good economic future for us all.

	Name	Address	Telephone
1.	[illegible]	1600 Tongass	225-9669
2.	[illegible]	1454 Water St.	225-9286
3.	[illegible]	P.O. 5345 KTN	225-9669
4.	[illegible]	P.O. Box 5755	225-6036
5.	[illegible]	P.O. Box 6044	225-5656
6.	[illegible]	925 Lund Ktn	225-9244
7.			
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PANHANDLE RIGGING LOFT
1600 Tongass Avenue
Ketchikan, Alaska 99901

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Win Green
Forest Supervisor
US Forest Service
Ketchikan, AK
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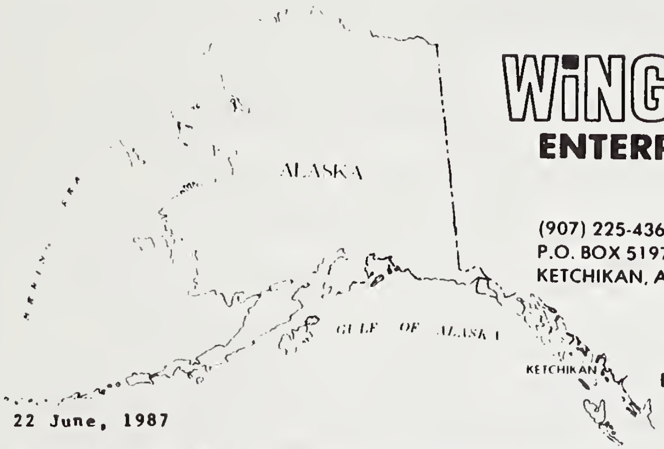

WiNGREN
ENTERPRISES

(907) 225-4365
P.O. BOX 5197
KETCHIKAN, ALASKA 99901

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22 June, 1987

Mr. Win Green, Forest Supervisor, Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green

My name is Paul Wingren. I spent my early years in a small fishing town in the Puget Sound area, LaConner, Washington. A good part of the economy of the area was, and still is, based on fishing, primarily salmon fishing. My family was a family of commercial fishermen, so I feel that I speak with a reasonable degree of first hand knowledge. Four methods of fishing were involved, namely trolling, gill netting, purse seining and fish traps. Fish traps have since been outlawed, but the other three methods still exist. There was, and still is, rivalry between the various gear types. The trollers cuss the gillnetters. The gillnetters cuss the purse seiners, and they all used to cuss the fish traps, for catching "our" fish.

In 1929 I moved to Ketchikan, Alaska, where I have lived continuously. As a retailer during most of that time, I have served the various segments of the fishing industry, and have had the opportunity to observe and to listen to most the opinions expressed. The philosophies and the patterns are pretty much the same wherever there are fishermen. With fish traps gone, except for a few still in operation by special privileged native groups, the various fishermen need a new target, a new "whipping boy". Aided, abetted and encouraged by the numerous well endowed environmental groups, they now target any other industry or natural resource that they feel, justly or unjustly, might in any remote way, be damaging to fisheries. Such, I believe, is a large part of the background

of the opposition to the use, by U. S. Borax (Pacific Coast Molybdenum Company) of the Wilson Arm/Smeaton Bay area for the disposal of tailings. I do not have the numbers, but you probably have, comparing the amount of silt moved by various Alaska rivers, with the amount of tailings that will be disposed of in Wilson Arm. I would suspect that the tonnage going into Wilson Arm would be surprisingly low by comparison.

Exploration has proven that there is a very valuable natural resource at Quartz Hill. The cost of extracting that resource is or will be a governing factor in the decision to develop or not develop the resource. It is my understanding that the difference in cost to U. S. Borax by using Wilson Arm/Smeaton Bay would result in an overall saving of some sixty million dollars, give or take a million or two. It is difficult for me to comprehend such large amounts of money, but if that is what it takes to get the mine in operation, I am all for it.

Sincerely

Paul J. Wingren

Paul J. Wingren

217

Michael & Kim Conley
1621 Moll Street
N. Tonawanda, NY 14120

June 25, 1987

Edward Johnson
US Forest Service
Federal Bldg.
Ketchikan, Alaska 99901

Re: Misty Fiords -- Quartz Hill Plan

I believe & support putting the tailings in the environmentally preferable Boca de Quadra basin.

No amount of money can replace the environment & the business should pay the price to do things they have to but at "no" cost of the environment that can in any way be avoided. Their gain is our loss. No More!

Kim Conley
Michael Conley

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6/24/87

218

Dear Mr. Johnson,

I am writing you in regards to the U.S. Forest Service's plan to dump mine tailings from the Quartz Hill molybdenum pit.

Of course, the mine is not yet a reality; only on paper. Yet, I'm sure you are aware that the enormous amount of tailings (480 thousand tons) could contaminate Wilson Arm for thousands of years. The fiord supports one of the Southeast's most vital salmon runs.

Please, resist the efforts of the Borax Corp. to change the EPA's mind about the disposal of these contaminants in Boca de Quadra basin!!

Thanks for your attention to this important manner,

Rick Chamberlin
Gustavus, AK.
99826
c/o Glacier Bay Lodge

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1090 BRIGHTON ROAD
TONAWANDA, N.Y. 14150
June 26, 1987

219

Mr. Edward P. Johnson

We are writing relative to the Quartz Hill Molybdenum mine in Misty Fjords National Monument.

We strongly support the EPA proposal to put the mine tailings into the Boca de Quadra Fjord and not into the Wilson Arm.

Sincerely

Eileen and William FAUST

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KETCHIKAN, AK 99901

220

Mrs. Sylver Carpenter
2772 E. Second Street
Long Beach, California 90803

June 26, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

This is to state my views regarding the Quartz Hill Project.

I am concerned with the social and economic future of Alaska; believe that the Quartz Hill Project can be an important element in that future and believe that environmental controls should be reasonable and that they must be balanced by economic considerations.

Very truly yours,

Mrs. Sylver Carpenter

cc: Mr. Robert S. Burd
Col. Wilbur Gregory
Mr. Bob Grogan

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A. KUSTKA AND S. LUCHESSA
463B KENSINGTON DRIVE #2
SAN DIEGO, CA 92116

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TONGASS NF
KETCHIKAN, AK 99901

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska
99901

26 June 1987

Dear Mr. Johnson,

I am writing in response to the mining at Quartz Hill in the middle of Misty Fjords National Monument. It's bad enough that mining is going on at all in a National Monument but the issue of where to deposit the thousands of tons of tailing has me especially concerned. The Forest Service wants to dump them in Wilson Arm, a spectacular fjord that supports one of Southeast Alaska's most important Salmon runs. The EPA opposes this site because it

may not be large enough to contain all the tailing, in which case the tailings would be resuspended and purpose waters would be contaminated. The EPA has suggested and prefers the far larger and less productive Boca de Quadra fjord.

The U.S. Borax Corp. is ~~opposed~~ against this idea because it says it will cost the company millions of dollars to dump the tailing in Boca de Quadra fjord. That is unfortunate but if it is environmentally safer and a better and larger place to dump there than I am for this site. I am opposed to this type of mining to begin with but to have more than one area disturbed or destroyed is out of the question — especially in a National Monument.

Please support the EPA's proposed site as it is better environmentaley — this land needs to be saved for our generation and future generation.

Sincerely,
Antoinette Kustka

SHARON L OSOWSKI

11139 BILL HILL EL PASO, TX 79936

Edward P. Johnson
U.S Forest Service
Federal Building
Ketchikan, Alaska 99901

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JUN 30 1987
TONGASS NF
KETCHIKAN, AK 99901

Dear Mr. Johnson:

I am writing to express my comments on the molybdenum mine at Quatz Hill in the middle of Misty Fjords National Monument. The proposed mine may last for 50 years; will be 2 mi long, 1 mile wide and 1/4 mi deep in the center ~~of~~ heart of the national monument. National Monuments should be protected from mining atrocities like this. Also a major concern is where to place the tailings after mining. The Forest Service wants to put them in Wilson Arm a spectacular fjord that supports one of Southeast Alaska's most important salmon run. Isn't the Forest Service suppose to protect wilderness areas from foul pollution like this?! The EPA opposes this site because the fjord may not be big enough to contain it all, in which case the tailings would be resuspended and surface waters would be contaminated. EPA prefers the larger and less productive Boca de Quadra fjord. Borax Corp says it will cost more money to dispose of it there. Isn't it time to make polluters pay for dumping? Even if the Boca site costs an arm and a leg, that's the safest place, and that's where they should put it.

Sincerely
Sharon L Osowski

SCOTT LUCHESSA
SYSTEMS ECOLOGY RESEARCH GROUP
SAN DIEGO STATE UNIVERSITY
SAN DIEGO, CA. 92182

6-27-87

MISTY FJORDS - QUARTZ HILL PLAN

MR EDWARD P. JOHNSON,

This letter is regarding the choice of disposal site for the tailings from the molybdenum mine at Quartz Hill. Though the Borax Corporation stands to lose money if the Boca de Quadra Fjord is chosen to be the disposal site for the mining operations billions of tons of tailings, the U.S. Forest Service has no obligation to increase a corporations profits. Regulating intelligent land use policies is a priority.

If the potential for the tailings to exceed the Wilson Arm of the fjords exists as the EPA purports, and the resuspension of particulates in the water column is a conceivable problem also, then the more logical and environmentally sound management strategy appears to be to select the Boca de Quadra Fjord as the disposal site. Especially since the sport and commercial fishing interests in the Wilson Arm are such substantial industries. Undoubtedly the productivity of the salmon fisheries in the Wilson Arm would be significantly impacted in a negative manner should the tailings from the molybdenum operation be deposited there. Please support the Environmental Protection Agencies impact statement and select the less productive Boca de Quadra Fjord as the disposal site for the Quartz Hill tailings

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Sincerely,

Scott Luchessa

224

2855 Tongass Avenue
Ketchikan, Alaska 99901
June 28, 1987

Mr. Win Green, Forest Supervisor
Forest Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green,

My wife and I are long-time residents of Ketchikan, our combined residence time here totaling 100 years. We would like to see the area developed in an orderly fashion with consideration to all concerns.

As local residents we have seen some of the US Borax activities and have talked to employees and contractors. The US Borax attention to detail is impressive and their attitude is to do the job right.

The national security of the United States is gradually being compromised by more and more dependence on foreign mineral sources. To offset this situation, it is time to encourage domestic mineral sources.

Environmentalist groups have brought up some important concerns, but existing laws should be able to take care of them and prevent any serious problems that could develop.

Alaska needs orderly economic development. If it is developed in a economically resonable manner, the US Borax mine could provide a stable economic base for this area. It might also serve as the base for economical area-wide distribution of electrical power.

We recommend the adoption of the development program requested by US Borax.

Sincerely yours,

George L. Beck
Mary L. Beck

George L. Beck
Mary L. Beck

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Q-178

225

Cape Fox Corporation
P.O. Box 8558
Ketchikan, Alaska 99901
(907) 225-5163

SAXMAN
CFC

June 29, 1987

Mr. Win Green
Forest Supervisor
U.S. Forest Service
U.S. Dept. Of Agriculture
Federal Building
Ketchikan, Alaska 99901

R.E. U.S. Borax Revised Draft E.I.S.

Dear Win,

The purpose of this letter is to express support for the use of Wilson Arm for the disposal of tailings from the Quartz Hill project. It is the obvious choice from an economic feasibilty standpoint. The information that has been compiled at great length and expense demonstrates that there is adequate capacity in Wilson Arm for the marine disposal of tailings for the life of the development.

I would also like to thank you for efforts to help find an environmentally safe and economically sound answer to this critical issue. This contribution that this project will make to Ketchikan and the rest of Southeast Alaska is extremely important to our economic future and the well being of our people.

Sincerely,
Cape Fox Corporation

Craig B. Burger
Chief Operating Officer

cc: Mr. Robert S. Burd, E.P.A.
Colonel Wilbur Gregory, Corps of Engineers
Governor Steve Cowper, State of Alaska
Mr. Bob Grogan, State of Alaska

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445 Front St.
Ketchikan, Ak. 99901
29 June, 1987

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KETCHIKAN, AK 99901

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Ak. 99901

Dear sir:

I see no wisdom in sacrificing currently economically viable, environmentally sound, renewable, resources (e.g. fishing and tourism) which have existing strong benefits to the local community in order to make a short-term project (Quartz Hill) more economically viable for a company that is not only not Alaskan, but not U.S. owned. They may have the right to mine, but they do not have the right to make things more difficult for others. For this reason I think it particularly shortsighted to overlook, or "go easy" on environmental considerations because U.S. Borax does not want to pay for them. I do not want to pay for them either, but if U.S. Borax is allowed to do as they will, when they are long gone my kids' kids will still be paying for the mistakes of today. So, please consider:

On land Tailings disposal and offshore tailings disposal were not given full consideration. However, if they cannot be further considered then I support EPA's position of dumping tailings into the middle basin of Boca de Quadra as the lesser of evils. To use Wilson Arm is to take much higher environmental risks.

I oppose all messing about with adjacent river systems including but not limited to placing a well field in the Wilson and damming the Blossom. To alter water levels and to impede fish movement will both adversely affect the fish populations.

This project is one of high environmental stakes, with a great potential for disaster. What effect, in the long range, will there be due to additional radioactive material being put into sounteast Alaskan waters and finely spread over the benthic community? Does anyone know? No. There are numerous existing molybdenum mines worldwide, some of ~~whom~~ which have little or no environmental constraints. U.S. Borax quite naturally is comparing this mine to those others. But this is not a third world country, This is the U.S.A. and the land status surrounding this proposed mine is wilderness area within a National Monument!! We must set a good example, and if mining is going to take place here, NO environmental safeguards should be waived or sacrificed. #1

Thank you very much for listening.

sincerely yours
Candia I. Coombs

Candia I Coombs

227

Greater Ketchikan Chamber of Commerce
P.O. Box 5957, Ketchikan, Alaska 99901
(907) 225-3184

June 29, 1987

Mr. Win Green, Forest Supervisor
U.S. Department of Agriculture, Forest Service
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

In 1984, the Greater Ketchikan Chamber of Commerce provided testimony in support of the continued development of the U.S. Borax Quartz Hill Molybdenum Mine Project and wishes to restate that position.

Tailings disposal should be allowed in Wilson Arm (preferred alternative of the U.S. Forest Service) rather than Boca de Quadra (preferred by the E.P.A.) on the basis of socio-economic impacta. The mine will have a lower cost of production which will allow it to remain open longer during down-market cycles, thus providing a more stable employment and economic base to the Ketchikan area. The tailings disposal studies have indicated there is no significant impact to the fisheries in either basin, therefore, we support tailings disposal in Wilson Arm.

The other concern the Greater Ketchikan Chamber of Commerce would like to reiterate its position on is the water supply for the mine. There are strong cost and reliability factors that lend themselves to allowing U.S. Borax to build a smaller dam, supplemented by the use of the wells in the Blossom River drainage as a secondary source of water. The Anilca Act provides sufficient safeguards to fisheries protection in this instance and again has socio-economic impacts related to the mine's lower cost of production based on a lower capitalization of the project. The project will have a reduced visual impact if it can be confined to one drainage, the Wilson River/Smeaton Bay area and if U.S. Borax is allowed to build the smaller dam in Tunnel Creek and supplement that reservoir with wells in the Blossom River drainage.

We feel it is essential to the long term stability of the region that the U.S. Borax development be safe yet cost effective.

Sincerely,

Jim Raabe
President
Greater Ketchikan Chamber of Commerce

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

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Mr. Win Green, Forest Supervisor
Forest Service
U S. Dept. Of Agriculture
Fêderal Building
Ketchikan, Alaska 99901

In regards to the permit for Quartz Hill project, I would like to see this project be permitted to begin operation. I enjoy living in S.E. and would like my family to be able to stay here. At the present I am concerned that my four teens will have to leave if order to make a living. What a shame when we can cooperate and use our God given minerals, fish and timber products, that people would argue instead of work together for all. I do believe that we must not environmentally do ourselves out of use of all natural entitities. I believe that good judgement , balanced judgement can be used to successfully have a viable operation. So lets continue to balance the economic factors and environmental factors ,use some give and take and then get on with the project.

What good will it do to have a wonderful envoronment if there are no people here to benefit. Or only the rich can afford to be here or come here.

I feel encouraged at the previous communication that Borax has done with our community. I would expect that to continue in planning as well as during operation.

Sincerely,

Danny and Terry

RT 1 BOX 962
KTN AK 99901

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229

DON YOUNG
CONGRESSMAN FOR ALL ALASKA

WASHINGTON OFFICE
2331 RAYBURN BUILDING
TELEPHONE 202/225-5765

COMMITTEES:
INTERIOR AND INSULAR AFFAIRS
MERCHANT MARINE AND FISHERIES
POST OFFICE AND CIVIL SERVICE

Congress of the United States
House of Representatives
Washington, D.C. 20515

DISTRICT OFFICES
701 C STREET, BOX 3
ANCHORAGE, ALASKA 99513
TELEPHONE 907/271-5978

BOX 10, 101 12TH AVENUE
FAIRBANKS, ALASKA 99701
TELEPHONE 907/456-0210

401 FEDERAL BUILDING
P.O. BOX 1247
JUNEAU, ALASKA 99802
TELEPHONE 907/586-7400

501 FEDERAL BUILDING
KETCHIKAN, ALASKA 99902
TELEPHONE 907/225-6880

RT 1, BOX 1605
KENAI, ALASKA 99611

BOX 177
KODIAK, ALASKA 99615

P.O. BOX 1860
NOME, ALASKA 99762

June 24, 1987

USDA-FOREST SERVICE
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FOREST SUPERVISORS OFFICE

Mr. Win Green
Forest Supervisor
U.S. Forest Service
USDA
Federal Building
Ketchikan, AK 99901

Dear Win

I strongly support the Forest Service preferred alternative for tailings disposal as set forth in the Quartz Hill project Revised Draft Environmental Impact Statement (RDEIS), which calls for the use of the Wilson Arm/Smeaton Bay proposal.

The RDEIS concludes that the use of either fjord would not have significant impact on salmon. Moreover, I understand that tailings discharge to the middle basin of Boca de Quadra would have a significant adverse impact on the economics of the project, and put off for some time the creation of badly needed jobs in the Ketchikan area.

The $59 million savings in capital costs and the additional savings of $1.6 million in annual operating costs that would result from the use of Wilson Arm for tailings disposal would bring nearer the date when this project could begin providing economic benefits to Southeast Alaska. Wilson Arm disposal would yield production and capital cost savings of 55 cents per pound at a time when molybdenum is hovering at approximately $3.25 per pound. The mineral economics of this project, then, are significantly enhanced by the preferred alternative, while at the same time there is no significant impact on the marine environment.

Finally, my position is influenced heavily by the fact that the preferred alternative holds the environmental impacts to one drainage area, and eliminates the need for a tunnel portal, tailings pipelines and facilities within the Boca de Quadra portion of the wilderness.

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Mr. Win Green
page 2
June 22, 1987

It is of critical importance to my state that the Quartz Hill project be economic and therefore competitive in the world market. Alaskans need jobs, and this project will provide them. In fact, this project will provide employment and revenue throughout its 55 year lifespan.

The National Environmental Policy Act recognizes the importance of and the need for projects like Quartz Hill. As you know, the intent of the Act is to not only protect the environment but also the economic and social well-being of the nation.

Therefore, I strongly urge you to stand by your original preferred alternative for tailings disposal, as it protects the environment and furthers the economic viability of the Quartz Hill project, a major job-producer in Southeast Alaska.

Sincerely,

DON YOUNG
Congressman for all Alaska

QUARTZ HILL PROJECT

USBORAX

	INIT	ACT.	INFO	DATE
FS				
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PLN				
PAS				
AO				
T.M.				
ENG				
F&W				
M&WS				
R&L				

June 26, 1987

Mr. Win Green
Forest Supervisor
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Re: Quartz Hill Molybdenum Project
Mine Development, Revised Draft
Environmental Impact Statement

Dear Mr. Green:

This letter constitutes some general comments on the preferred alternative portion of the Revised Draft Environmental Impact Statement (RDEIS). A separate letter will be sent giving more detailed comments on the whole of the RDEIS including the Appendices.

The specific points we wish to comment upon in this letter involve the selection of a site for tailings disposal and the sources of water supply for the project, which in our opinion are the two major issues in the preferred alternative. The objective of our comments is to promote the permitting of a project concept which will provide adequate protection for the environment, including fisheries resources, while at the same time ensuring a cost-effective design and a financially sound and economically viable project. This in turn will provide greater assurance that the benefits of the project will be realized by the people of the Ketchikan area.

Tailings Disposal

U.S. Borax supports the Forest Service's preferred alternative of marine disposal in the Wilson Arm and strongly disagrees with EPA's interim conclusion that the middle basin of Boca de Quadra is the environmentally preferred location for mill tailings disposal. Up to this point, EPA in its role as the issuer of the NPDES permit for the tailings discharge, has considered only the marine impacts. However, we believe that EPA is aware that for the Final EIS, other environmental and #1

UNITED STATES BORAX & CHEMICAL CORPORATION · 3075 WILSHIRE BOULEVARD · LOS ANGELES, CALIFORNIA 90010 · (213) 381-5311
MAIL ADDRESS: P. O. BOX 75128 SANFORD STATION, LOS ANGELES, CALIFORNIA 90075

230

economic factors must be considered. Economic factors such as significant cost differentials have their own environmental (socioeconomic) impacts. A consideration of all the impacts leads inevitably to the conclusion that Wilson Arm/Smeaton Bay is the environmentally preferred tailings disposal location.

#1 cont.

A great deal of research and scientific work has been done over the last ten years by some of the world's foremost experts, including the University of Alaska and Rescan Environmental Services, Ltd., which has had experience with successful marine tailings disposal operations around the world. The experts all agree that the risks from marine tailings disposal to the fisheries resources will be very small with either Wilson Arm/Smeaton Bay or Boca de Quadra, and that the differences in marine impacts between these two fjords are not significant. Further, the experts have agreed that disposal of tailings into the marine environment at a depth of about 150 feet will not pose a threat to the salmon resources, since the tailings material will stay below the upper part of the water column used by the salmon. The RDEIS concurs with this in stating (p. xii) that "all tailings impacts to salmon would be insignificant."

In view of the low level of impacts of tailings disposal to fisheries resources and in the absence of significant differences in the marine impacts between the two fjords, U.S. Borax feels that the perceived differences in other potential impacts should be the principal deciding factor.

These differences are considerable, as the Forest Service has pointed out. The use of Wilson Arm/Smeaton Bay would allow confining project impacts to one drainage basin, help preserve Wilderness values and avoid cost differences equating to about 55 cents per pound of molybdenum. Imposing a cost burden of this magnitude by requiring use of Boca de Quadra would inevitably delay the start of the project and sap the economic strength needed to continue operations through future molybdenum price dips. The consequent delay and added economic uncertainty must be considered a socioeconomic disadvantage for the Boca de Quadra option.

#2

Some of the principal points involved in the comparison between Wilson Arm/Smeaton Bay and Boca de Quadra can be summarized as follows:

- The risks of marine disposal to the fisheries, including salmon, are very small in either fjord.

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- There is little difference in marine impacts between the two fjords.
- The capital cost increase in using Boca de Quadra as a tailings disposal site is approximately $59 million; and the operating cost increase $1.6 million a year (about $4,400 per day). This equates to an equivalent increase in production cost of 55 cents per pound of molybdenum.
- Use of Wilson Arm/Smeaton Bay would allow confining the impacts of the project to one drainage basin.
- Use of Wilson Arm/Smeaton Bay would avoid having to construct and maintain facilities in the Wilderness at the Boca de Quadra tunnel portal, thus preserving Wilderness values.
- Marine biology experts have stated that shallowing of the fjord by means of tailings deposition would result in increased fjord biological productivity. This beneficial effect would be greater in Wilson Arm/Smeaton Bay than in Boca de Quadra.
- EPA's concern about the possibility of copper toxicity in the discharge is based on very conservative "worst case" assumptions, both for the levels of dissolved copper in the effluent and for the value representing the threshold level for acute toxicity. From the pilot plant testing U.S. Borax did on bulk ore samples, we are satisfied that the outfall facilities can be designed so that the copper levels in the tailings slurry at the end of the pipeline will be below acutely toxic levels.
- EPA's concern about possible loss of minor amounts of fines into Behm Canal is not supported by the existing tests and research data. National Marine Fisheries has given an opinion that this eventuality "would not likely result in a discernible impact to the fishery resources of Behm Canal."

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- EPA's concern about tailings deposited in Wilson Arm eventually rising to above the 100 meter level at the outfall can be mitigated, if it is indeed a problem, by moving the outfall downfjord after about 45 years of operation.

- Tests on the expected compaction of tailings at the bottom of the fjord indicate that Wilson Arm has adequate capacity to hold the entire known volume of the orebody in the form of tailings.

- The remote possibility of effects of marine tailings disposal on the fjord estuary is similar for both fjords and could be avoided, before it becomes significant, by moving the outfall further downfjord.

A point to be stressed is that any suspected impacts from tailings disposal are long term and through monitoring, will be seen long in advance. Therefore, there will be ample time to put any required mitigation measures into effect. Since the risks to fisheries are predicted to be very low with either fjord, any incremental advantages of Boca de Quadra are small and are more than counterbalanced by the advantages of Wilson Arm/Smeaton Bay in other respects.

#3

As previously stated, when <u>all</u> impacts are considered, including economics, Wilson Arm/Smeaton Bay must be considered the preferred location for tailings disposal. We submit that a dispassionate review of all of the great mass of data which U.S. Borax has provided for this EIS will lead to that conclusion.

<u>Water Supply</u>

The Forest Service's preferred alternative is to obtain all of the process water during the first phase of operations from a dam in the Tunnel Creek Valley. This would be supplemented, only when the plant is expanded in Phase II, from a secondary source near the mouth of the Blossom River. Since this location is below the spawning habitat on the Blossom, there would be minimal risk to the fisheries.

U.S. Borax sees two problems with this proposal, cost and reliability. The Forest Service plan, which is to build a dam 110 feet high to provide the storage needed to avoid possible plant shutdowns during dry periods, would cost over $30 million

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more than the Borax proposal, which has been to build a dam only 52 feet high but to supplement this during Phase I with wells near the Wilson River.

U.S. Borax considers it very important to have the added reliability of a supplementary water source during Phase I, to lessen the risk of temporary plant shutdowns and consequent socioeconomic impacts on the Ketchikan community. However, it is recognized that the use of Wilson River wells would require careful control of withdrawal rates to avoid risks to the salmon spawning areas. U.S. Borax has committed to doing this, but the restriction in itself is a negative reliability factor.

#4

As an alternative, U.S. Borax proposes that the supplemental Blossom River source preferred by the Forest Service be made available for use <u>during Phase I</u>, when the plant is at one half of its ultimate capacity. This will avoid the environmental risks and restrictions of the Wilson River wells. During the course of Phase I, there will be ample time to investigate sources for the additional water needed for Phase II. Possibilities include greater withdrawals from the Blossom River, raising the Tunnel Creek dam or developing a tertiary supplemental source.

#5

Regarding use of the Blossom River, concerns have been expressed about possible impedance to fish movements of a weir constructed across the river mouth. The weir was proposed as part of an earlier plan, to prevent drawing saltwater into the intake pipe during extreme high tides. That plan, however, did not include reservoir storage on Tunnel Creek, and the addition of a minimum of 7 days storage as part of the current plan is felt to give sufficient operational flexibility to allow timing water withdrawals from the Blossom to those periods when saltwater will not be present. It is therefore probable that the weir will not be required.

In summary, our proposal for water supply is as follows:

- During Phase I, primary supply from a reservoir on Tunnel Creek, using a dam at least 50 feet high.

- During Phase I, supplement the Tunnel Creek supply with the secondary supply source near the mouth of the Blossom River as proposed by the Forest Service, but probably deleting the weir.

Mr. Win Green -6- June 26, 1987
U.S. Forest Service

o For Phase II water supply, investigate sources of additional water during the course of Phase I, with preference for increasing withdrawals from the Blossom River secondary source if the flow proves adequate.

We feel that this proposal is the best for environmental protection as well as ensuring low cost and reliable water supply sources for both Phases I and II.

For the Quartz Hill Project as a whole, U.S. Borax is committed to construction and operation in an environmentally sound and cost-effective manner. We are prepared to do whatever is reasonably necessary to assure protection of water quality and fisheries. However, for maximum benefit to the community, the project must be economically viable before it can proceed and must be financially strong once it starts.

Adequate protection for the fisheries and other aspects of the environment is assured by ANILCA and other existing laws. U.S. Borax has demonstrated its concern for the environment by means of its record in Alaska and its operations elsewhere.

Yours sincerely,

C. A. Hesse
Vice President &
Project Manager, Quartz Hill

CAH:ss

cc: Mr. Robert S. Burd
U.S. Environmental Protection Agency
Seattle, Washington

Colonel Wilbur Gregory
Corps of Engineers
Anchorage, Alaska

Mr. Bob Grogan
Office of the Governor
Juneau, Alaska

3CH2-4

P.O. Box 306
Thorne Bay, AK 99919
June 2?, 1987

Mr. Win Green, Forest Supervisor
U.S. Forest Service
Federal Building
Ketchikan, AK 99901

Dear Win:

Lew Williams' column in the "Weekend Edition" of the Ketchikan Daily News reminded us to comment on the alternatives for mine development at Quartz Hill.

We favor acceptance of tailings' disposal in Wilson Arm with attendant mill and pipeline location. My reasons for preferring the Wilson Arm alternative are:

1. I am familiar with the area, the resources, values involved, biases, concerns, and arguments pro and con.
2. I accept your decision, based on the interdisciplinary team process, knowing, if any bias exists, it is toward preservation of the resources over economic development.
3. My experience in working with key people of U.S. Borax gives me confidence in their management of the property. They will go the extra mile (or $1 million) to protect other resources. They are more at risk with their considerable investment than the likelihood of jeopardy to the production of fish, crab, shrimp, etc.
4. The area, state and nation need to go forward with projects of this type to compete. Let's quit studying, researching, and planning.

As I write this I am sitting in the South Arm of Thorne Bay looking at an A-frame setting, clearcut some years ago (20-25). The young growth, spruce and hemlock, completely covers the area logged, providing a beautiful contrast to the adjacent old growth of spiked top, decadent cedar and hemlock. We dined on shrimp and crab last night from our pots set in the bay. Our catch of salmon and halibut so far has been easier than we experienced around Ketchikan. We see deer and bear on the beach, and mink and otter live near us. A great blue heron is a daily visitor. All in spite of the logged area, many years of log rafting and traffic in the bay. It becomes more and more difficult for us to understand the cries

of doom of SEACC, the Sierra Club, fishermen, biologists, and oth r special interest groups with the "chicken little" complex. The same individuals and groups that want everything studied to death, delay projects through court suits, add undue bureaucracy and attendant tax expenses. They also prefer Boca de Quadra.

Very truly yours,

Jim Watson · Bette Watson

Jim Watson

KETCHIKAN GATEWAY BOROUGH
344 Front Street
Ketchikan, Alaska 99901
(907) 225-6151

USDA - FOREST SERVICE
KETCHIKAN AREA
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JUL 1 '87
FOREST SUPERVISORS OFFICE
FS
DFS
PLN
PAS
AO
T.M.
ENG
F&W
M&WS
R&L

June 29, 1987

Mr. Win Green
Forest Supervisor
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Win:

Before the comment period expires I want to express my grave concerns over the probable mitigation of socio-economic impacts associated with the development of Quartz Hill. I am registering these comments as an individual member of the Borough Assembly and the Community Liaison Committee currently negotiating with U.S. Borax.

The task of mitigating the socio-economic impacts has been transferred to the community of Ketchikan and U.S. Borax since the commute option was chosen as the preferred alternative. The task is quite sizable as the project will result in :

- A peak of 2,758 additional persons in Ketchikan
- A peak of 450 people looking for work unsuccessfully (speculative in-mitigation)
- A peak of 927 new housing units
- A peak of 748 new school-age children

The list of impacts included in the Revised DEIS goes on, but all these impacts are compounded by the fact that U.S. Borax would not be paying local property taxes for any of the mine area facilities.

#1

The already challenging task of mitigation has been intensified by 1) the lack of substantive progress in the negotiations with U.S. Borax on impact mitigation and 2) the U.S. Forest Service's failure to treat the socio-economic impacts as serious as the environmental impacts. The recent letter to Mayor Ralph Gregory dated May 19, 1987, states:

> "Nothing in these authorities allows us to condition our approval of actions off the National Forest. Therefore, we do not intend to condition our approvals of the operating plan for actions to be undertaken within the Ketchikan community."

Yet the U.S. Forest Service is very involved and intends to condition the record of decision (R.O.D.) to address the tailings disposal, water quality and fisheries impact issues all of which are impacts that occur off the National Forest as they occur in State waters. Where is the consistency in your rulings? Are you suggesting that fish are more important than people? #2

With such a ruling, the successful mitigation of impacts now rest with 1) the community's and Borax's reluctance to annex Quartz Hill and/or 2) U.S. Borax's desire to be a good corporate citizen. Meaning no offense to U.S. Borax, but that puts the community at risk. I feel strongly that Ketchikan is vulnerable to significant adverse socio-economic impacts. I say this knowing full well that the negotiations will continue with my sincere participation.

I am copying this letter to the State as they too are at risk because the State is the ultimate source of financing for basic public services.

I support the project on the basis that growth should pay its own way. U.S. Borax is willing to pay their fair share of costs to mitigate the impacts on Ketchikan, but without leverage provided by the Forest Service under NEPA, "fair share" will be defined by market place economics and not ultimately by what is best for the community. Hence, Ketchikan is vulnerable and the RDEIS should not assume that the impacts will be successfully mitigated. #3

Sincerely yours,

Kate Troll

Kathryn Troll
P.O. Box 7903
Ketchikan, Alaska 99901

cc: Bob Grogan, Director, Division of Government Coordination

TERRY R. WILLS
MINK BAY
BOX 9217
Ketchikan, AK 99928

ATTN: BOB LATHAM
DEAR BOB,

I AM WRITING CONCERNING THE DECISION TO PUT THE U.S. BORAX MINE TAILINGS IN BOCA de QUADRA OR WILSON ARM. I WILL NOT HAVE TIME TO GATHER FACTS & ~~FIGURES~~ FIGURES AS I DID NOT REALIZE THE TIME PERIOD IS UP ON JUNE 30.

IT MAKES SENSE TO DUMP THE TAILINGS INTO WILSON ARM AS I UNDERSTAND IT IS CAPABLE OF HANDLING THE PROJECT AND ALSO IT WILL BE THE SALT WATER MINE ACCESS SO WILL ALREADY HAVE THE MARINE & PEDRE TRAFFIC.

AS FAR AS PUTTING TAILINGS IN BOCA de QUADRA, IT IS NOT JUST THE TAILINGS IMPACT BUT THE PEOPLE IMPACT THAT WOULD BE BAD. QUADRA HAS THREE LARGE RIVERS SO IT WOULD BE A SHAME TO HAVE THE IMPACT ON BOTH QUADRA AND WILSON SIDES.

I DO NOT KNOW HOW MUCH OF AN IMPACT THE TAILINGS WOULD HAVE ON SALMON OR FISHERIES BUT IF THIS IS A FACTOR I FEEL BOCA de QUADRA SHOULD HAVE A FAIR AND COMPLETE STUDY ON THE FISH RESOURCE.

BESIDES HAVING THREE (3) LARGE PINK SALMON STREAMS AND SEVERAL SMALLER ONES THERE ARE GOOD SILVER AND KING SALMON RUNS. PLUS HUGH SMITH LAKE WHICH HAS THE ONLY GOOD SOCKEYE STREAM IN THE SOUTH END.

AS FOR MY OWN PERSONAL REASONS, THERE

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#2

Is very little private property in the Monument. There is none in Wilson Arm. I own 34 acres at Mine Bay, in Boca de Quadra. I am building a small lodge on that site.

I realize, compared to the Borax Project that it probably seems insignificant but to me it is very important.

I feel that dumping the tailings on the Quadra side would have a very negative effect on my future.

If there were no alternative I would say go ahead as I feel we need developement in this state. But to me it makes little or no sense to screw up more country or areas when not absolutely necessary.

I am sure that the cost for dumping tailings in Boca de Quadra would be very costly as compared to the Wilson Arm side. If the mine project is ever to become a feasible reality these costs and thoughts should be taken into consideration.

Sincerely,

Terry R. Wills

USDA Forest Service
Misty Fiords
National Monument
Received

Jul 1 - '87

X	Ranger	
	Rec/Wild	
	Lands/Min.	
	Fish/Wldf	
	MTNC	
	File Gen	
	Misty	
	Personal	
	Library	

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Bechtel Group, Inc.

Fifty Beale Street
San Francisco, California
Mail Address: PO Box 3965, San Francisco, CA 94119

June 23, 1987

Mr. Win Green
Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The purpose of this letter is to express our support of the Forest Service's Preferred Alternative for development of the Quartz Hill Molybdenum Project. Representing approximately 10 percent of the world's known reserves of this strategic mineral, Quartz Hill is important to our national security and will enhance Alaska's social and economic development.

Bechtel has significant experience with this project, having provided engineering, environmental and construction management support to U.S. Borax from 1982 to 1984. We are familiar with the unique geographic, climatological and logistics characteristics of the site as well as the special requirements for environmental protection under the Alaska National Interest Lands Conservation Act. Based on this knowledge, we believe the Forest Service's Preferred Alternative generally represents an equitable balancing of environmental and economic values, consistent with national and State of Alaska interests. Having conducted detailed studies of tailings disposal in the Wilson Arm-Smeaton Bay and Boca de Quadra fjords, we particularly support the Forest Service's preference for tailings disposal in Wilson Arm-Smeaton Bay.

The Bechtel Group strongly supports development of an economically competitive project that incorporates reasonable environmental safeguards. Thank you for this opportunity to comment.

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KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

Very truly yours,

J. Neerhout, Jr.
Executive Vice President

Bechtel Western Power Corporation — Bechtel Eastern Power Corporation — Bechtel Civil Inc
Bechtel, Inc — Bechtel National, Inc — Bechtel Limited
Operating Companies of Bechtel Group Inc

12079 (6/86)

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RECEIVED
KETCHIKAN AREA

JUL 1 1987

TONGASS ...
KETCHIKAN, AK 99901

June 23, 1987

Re: U.S. BOrax Mine

Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Sir;

This letter concerns the Borax mining project in the Misty Fjords National Monument, or more specifically the disposal of tailings into Wilson Arm.

I am 17 year resident of Alaska and have spent considerable time in and around the area. I was elated that this area was given "National Monument" status, as it well deserves.

Q-188

#1

I was disappointed to hear that a mine, especially of this magnitude, was planned in this area. The impact of the people and townsite alone, was cause for concern. Then there is the scaring of the land in such a pristine area, along with the sounds of industry echoing through the otherwise tranquil "fjords". All of this is supposed to be progress, I suppose, and indeed it shall probably help the economy of this area. However, upon hearing of the newly proposed disposal of tailings in Wilson Arm, the plans for a "well field" on the Wilson River, and even a dam on the Blossom River, and other as yet unknown insults to the region; I am horrified!

How is it that such things could happen in an area that was especially set aside so that the people of Alaska, the greater United States and yes, the "world", could have at least some notion of what the world was like before the headlong intrusion of so called progress? In short, I don't believe this project should ever have been approved. I suppose that is now an issue too late to change, however there is still a chance to at least reduce the impact.

Being familiar with the ANILCA funding and how the public has been forced to subsidize an industry which has manipulated the economy and resources of this region. I should hope that we will not make the same mistake twice. I am tired of giving over to industry concessions which enhance their profit margins of which precious little is returned to the public and region from which they came.

#2

The proposed river projects in this case, not to mention the dumping of tailings in the relatively confined Wilson Arm, are in my estimation a great infringement on the one industry of any consistance in this area; that of the fisheries. Yes I suppose that these projects will

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Page 2
Borax Mine

#2 cont.

save Borax millions, but at the cost of jeopardizing a natural industry that has been millions of years in development.

#3

Given the long term duration of this mining operation I should think that it would provide ample time to recoupe these losses in the long run. Why not do it right the first time? Why not spend a bit of money now in prevention rather than alot of money later trying to rectify a rash and impulsive act to entice and make easier a project of such magnitude that will most assuredly proceed anyway? I for one, would feel better living in this present economy a little longer knowing that in the long run, I didn't sell out to a "quick fix" situation at the cost of yet another of the few remaining unspoiled corners of Southeast Alaska.

I support the EPA's position of dumping the tailings in Boca de Quadra and whatever can be done to protect the forenamed river systems. You Sir, are in the position to help make these changes, and I hope you will give grave consideration to these and other issues concerning this our "last frontier".

Respectfully,

Philip M Stage

Philip Stage
General Delivery
Loring , Alaska 99950

cc: Governor Steve Cowper, State of Alaska
Robert Burd, Director EPA Water Division
Col. Wilbur Gregory, District Engineer-Corps of Engineers

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RECEIVED
USDA—FOREST SERVICE
KETCHIKAN AREA
JUL 2 '87
FOREST SUPERVISORS OFFICE

6234 Powell Road
Parker, Colorado 80134
June 25, 1987

1) Ketchikan #136 ACTION
cc: (response)
2) RF DRF ~~FOR SIGNATURE~~ 7/1
+ LMW

Michael Barton
Regional Forester, Alaska Region
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Regional Forester

I have reviewed the Revised Draft Environmental Impact Statement For The Quartz Hill Molybdenum Project Mine Development.

I support the Environmental Protection Agency Preferred Alternative that would have the mine tailings disposal in Boca De Quadra instead of the Wilson Arm site. I feel that this would be a less environmentally damaging site for tailings disposal.

I do however feel a project of this size will severely damage the environment and would strongly urge the Forest Service to protect environmental resources in

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the area as specified in ANILCA.

Thank you

Lawrence A Papp

M. Dillon
[illegible] Road
Elma, NY [illegible]

June 26, 1987

Mr. Edward P. Johnson
U. S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Sir:

Re: Molybdenum mine at Quartz Hill in the middle of Misty Fjords Nat. Monument

I understand the Forest Service wants to put the tailings after mining in Wilson Arm, a spectacular fjord that supports one of SE Alaska's most important sahon runs.

EPA opposes this site because the fjord may not be big enough to contain all the tailings, in which case the tailings would be resuspended and surface waters would be contaminated. It prefers the far larger and less productive Boca de Quadra fjord.

As a member of the Buffalo Audubon Society I have an interest in the environment and urge that the EPA's wished be adhered to.

I would appreciate a reply.

Sincerely,

Mary M. Dillon

Mary M. Dillon

RECEIVED
KETCHIKAN A[illegible]
JUL 1 1987
TONGA[illegible]
KETCHIKAN, [illegible] 99901

208 Paul Drive
Mt. Juliet TN 37122
June 26, 1987

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I would like to urge the Forest Service to accept the EPA recommendations that tailings from the Quartz Hill molybdenum mine be placed in Boca de Quadra fjord not in Wilson Arm. Private companies such as the U.S. Borax Corp. should not be allowed to influence decisions which are more environmentally sound. Tailings placed in Wilson Arm may have a substantial detrimental affect on the salmon runs of Wilson Arm which are a continuing resource which can exist long after mining is finished at Quartz Hill if they are not destroyed. I believe the Forest Service should look after the public interests not those of mining companies.

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JUL 1 1987
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KETCHIKAN, AK 99901

Sincerely,

Jerry L. Morrisey

Harold L. Dittmer
3911 Fernwood Avenue
Los Angeles Calif 90027

26 June 1987

Edward P. Johnson
U.S. Forest Service
Federal Building
Ketchikan
Alaska, 99901

Dear Mr. Johnson:

A bit tardy and hopefully not late to submit my "22 cents" worth of comments on the Quartz Hill molybdenum mine in the midst of the Misty Fjords National monument.

If EPA has opposed the Forest Service's plan to place the mine tailings in Wilson Arm and prefers the larger and less productive Boca de Quadra Fjord my gut feeling is that I would agree. Obviously the U.S. Borax Corporation would prefer to save money. But is it in the best interest of this spectacular region of Alaska to not consider the overall picture and impact? And in fifty years time will not the U.S. Borax Corp. be able to live with and finance the operation.

Please enter and register my rejection of the Wilson Arm as a tailing site and use a more environmentally suited Boca de Quadra site.

Yours sincerely,

Harold L. Dittmer

Harold L. Dittmer

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KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

MARLENE CLARKE
OWNER

P.O. BOX 1020
WRANGELL, ALASKA 99929
(907) 874-2125

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KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

Joy's FINE GIFTS

29 June '87

Ed Johnson
USFS
Fed Bldg.
Ketchikan, AK 99901

Dear Sir:

Please be advised that if the U.S. Borax project is approved, Borax should be expected to pay a fair price to mine.

If tailings must be dumped I support the EPA's position to put them in the middle basin of Boca de Quadra & I oppose any tailing dumping in the Wilson Arm.

I oppose all proposals for a weir field for water in the valuable Wilson River.

I oppose draining supplemented water from the Blossom River & construction of a weir/low dam system which would impede fish movement.

#1 Generally I oppose the project as I feel further study is needed on dumping tailings on land based sites. I also believe the Wilson Arm & Wilson-Blossom Rivers should be left alone.

Thank you for considering my opinions.

Sincerely yours,

Marlene Clarke

cc. Gov. Steve Cowper
Robert Burd, EPA
[illegible]

241

Tl'átk Saxman

City of Saxman
Rt. 2, Box 1
Saxman, Alaska 99901
(907) 225-4166

June 26, 1987

RECEIVED
KETCHIKAN AREA
JUL 1 1987
TONGAS[illegible]
KETCHIKAN, [illegible]

Mr. Win Green
Forest Supervisor
U.S. Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Re: U.S. Borax Quartz Hill Project
Smeaton Bay/Wilson Arm Tailings Disposal

Dear Mr. Green

Representing the City of Saxman on the Ketchikan Community Liaison Committee, I have had the unique opportunity to review and evaluate reams of information (including the DEIS and Revised DEIS) regarding the proposed mine development at Quartz Hill, as well as, discuss with U.S. Borax personnel anticipated socio-economic issues impacting the Ketchikan Community. Addressing specifically the economics for mine development regarding tailings disposal, I have the following comment:

It's clear to me enough data has been generated to support mine tailings disposal in Smeaton Bay/Wilson Arm. Tailings disposal in Boca de Quadra may be less an environmental risk than Wilson Arm, however, studies have shown Wilson Arm is not at risk and is certainly more economically feasible. Omitting economic concerns, a decision to permit tailings disposal in Wilson Arm is substantiated by environmental impact research data. Consequently, I support the decision to permit tailings disposal in Wilson Arm.

Much is at stake for the Ketchikan Community with respect to the Quartz Hill project. Every effort should be made to guarantee successful mine development without compromising the natural or Community environment. Protecting the environment while providing a viable economic future for the Ketchikan Community and State of Alaska is possible. Every effort to assist economic mine development without compromising the environment should be made. Permitting tailings disposal in Smeaton Bay/Wilson Arm is such an effort.

Sincerely,

James E. Swink
James E. Swink
Mayor

cc Mr. Bob Grogan, Office of the Governor
Colonel Wilbur Gregory, US Army Corps
Mr. Robert S. Burd, EPA

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June 26, 1987

Mr. Win Green
Forest Supervisor
Untied States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Win:

I have followed the saga of the Quartz Hill molybdenum deposit since its discovery, and added a few pages before to the four-story high stack of material now extant on the project environmental impact statements.

This time, I think it's time to fish or cut bait. Millions of dollars have been spent on the studies, and the information assembled by the scientists comes in backing up the tailings disposal proposal that also would be the most economically advantageous to the project: ie, the overall environmental impact is less if the tailings are disposed in Wilson Arm, and the overall costs of development and operation would be significantly less.

The importance of recognizing the need to allow the project to be positioned profitably, so that once in operation it can remain economically viable, cannot be overemphasized. When the market for molybdenum improves, as it will, and the mine and mill can become a significant part of the employment scene in Southeast Alaska, a work force will be resident in this area dependant on that employment. These people will not be able to pick up and move down any highway to look for other work during any closure of the project. We are all aware of our isolation in terms of job opportunities, and the need to keep steady employment available.

We need to be realistic. The mineral deposit is where it is; the surrounding environment has been completely studied and assured every safeguard conceivable. Now let's plug in the equation that will provide for the worker's welfare.

Please put my comments in the pile that supports the Wilson Arm tailings disposal. It is the overall environmental, economic and reasonable decision to make.

Thank you.

Sincerely,

Helen Finney
Helen Finney
Box 682
Ward Cove, AK 99928

cc: Mr. Robert S. Burd
Colonel Wilbur Gregory
Mr. Bob Grogan

RECEIVED
KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

ALASKA APPRAISAL ASSOCIATES

REAL ESTATE APPRAISERS & VALUATION CONSULTANTS

June 29. 1987

RECEIVED
KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

Mr. Win Green
Forest Supervisor
U.S. Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

The U.S. Borax Quartz Hill molybdenum project is a highly desired project. The project has the potential for providing economic diversification away from the seasonal timber, fishing and tourist industries.

Ketchikan and the outlying communities have experienced unemployment rates ranging from 11% to 30% over the past 3 years. Year-round jobs to be provided by the Quartz Hill project will contribute to a more stabilized economy.

The creation of a stable, year-round, long term mining project is of foremost importance. To assure year-round operation, it is necessary that the mine be placed in production at the lowest possible cost. The proposed dumping of tailings in Wilson Arm will help effect this low cost operation. Studies have shown that the tailings dumping can be accommodated within Wilson Arm with no significant environmental impact.

It is not environmentally prudent to impact Boca de Quadra with tailings disposal. Development should be restricted to the Wilson Arm area. This makes sense both from an environmental and economic standpoint.

The future of Alaska depends upon reasonable environmental controls that will encourage development of Alaska's resources. The proposed operating plan offered by U.S. Borax exemplifies a balanced approach to development.

Sincerely,

Kim M. Wold
Kim M. Wold

P.O. Box 6063
Ketchikan, Alaska 99901
907-225-9421

USBORAX

June 29, 1987

Mr. Win Green, Forest Supervisor
U.S. Department of Agriculture
Forest Service
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Subject: Comments on the Revised Draft Environmental Impact Statement, Quartz Hill Molybdenum Project, Mine Development (RDEIS)

Dear Mr. Green:

On behalf of Pacific Coast Molybdenum Company, U.S. Borax is pleased to respond to the Forest Service's request for comment on the Revised Draft Environmental Impact Statement for the mine development phase of the Quartz Hill Molybdenum Project. In another letter, mailed under separate cover, we are commenting on the preferred alternative section of the RDEIS.

The attached comments include those made on the EPA's Best Professional Judgment Report (Draft). A separate letter has been prepared addressing our comments on the U.S. Army, Corps of Engineers Section 404 (b)(1) evaluation and Public Notice.

We hope that our comments will be of assistance to the Forest Service in making its final determination. Should you have any questions, please do not hesitate to call either Ken Reim, Don Finney, or the writer.

Sincerely,

C. A. Hesse
Vice President & Project Manager
Quartz Hill

CAH:ems
Attachment

USDA FOREST SERVICE
KETCHIKAN AREA
RECEIVED
JUL 1 '87
FOREST SUPERVISORS OFFICE

FS				
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PAL				

UNITED STATES BORAX & CHEMICAL CORPORATION • 3075 WILSHIRE BOULEVARD • LOS ANGELES
MAIL ADDRESS P.O. BOX 75128 SANFORD STATION, LOS ANGELES, CA

cc: U.S. Army Corps of Engineers
Alaska District
Pouch 898
Anchorage, Alaska 99506

Attention: Col. Wilbur Gregory
District Engineer

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Attention: Mr. Robert S. Burd, Director
Water Division

Office of Management & Budget
Division of Governmental Coordination
Pouch AM
Juneau, Alaska 99811

Attention: Mr. Robert Grogan, Director

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COMMENTS TO THE
REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT
QUARTZ HILL MOLYBDENUM PROJECT, MINE DEVELOPMENT
TONGASS NATIONAL FOREST, ALASKA

GENERAL COMMENTS

Tailings Disposal

U.S. Borax has provided extensive information over several years on the subject of marine disposal of tailings. This information, which has been developed in large degree by recognized experts in the field, has been provided to all Federal and State agencies concerned with this aspect of the project. We are convinced that this information shows conclusively that there will be little or no degradation of the water quality or fisheries resources in either Boca de Quadra or Wilson Arm/Smeaton Bay fjords.

Appendix S, which is also commented upon in this letter, consists of EPA's Best Professional Judgment evaluation of tailings disposal in each fjord. This evaluation considers only the perceived impacts on the marine environment. EPA's conclusions indicate the differences between the two fjords are essentially minor; the basic conclusion being that whatever risks there are would be less in a larger and somewhat deeper basin. There can be little argument with such a conclusion when viewed in this narrow fashion.

What is very strongly arguable, however, is that the differences, if there are any, are minor and therefore other environmental factors must be considered. These other factors, which must be given equal weight in the overall Final EIS decision, include:

1. The potential socioeconomic impacts on Ketchikan and Alaska in general due to economic uncertainties resulting from unnecessary added capital and operating costs.

2. The undesirability of impacting two drainage basins when a totally acceptable project is possible which impacts only one basin.

3. The undesirability of impacting the Wilderness area of the Misty Fjords National Monument when a totally acceptable project is possible which does not impact any Wilderness areas.

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The latter two factors were considered vital by project opponents in the early stages of project development. They are no less important now.

SPECIFIC COMMENTS

SUMMARY PAGE xi, para 3

#1

"More information is needed to show that milling reagent toxicity is not a problem". Bioassays of tailings based on the planned suite of reagents show no problem. Other similar operating tailings disposal systems using similar reagents, i.e. Island Copper and Kitsault, have not shown any significant milling reagent toxicity. Further, bioassays will be a part of the permit requirements. Sufficient information is available to determine either that there will be no "unreasonable degradation" or that there would be no "irreparable harm" during a monitoring period.

SUMMARY PAGE xv - xvi

The following comments are intended to clarify the itemized statements under the headings Boca de Quadra and Wilson Arm/Smeaton Bay:

BOCA DE QUADRA

#2

1. "There is minimal possibility for suspended tailings to reach the upper part of the water column (water depth less than 100 m) and affect fish and shellfish or their food sources."

   Discharge into Smeaton Bay/Wilson Arm will have a similar minimal possibility. As stated in EPA's Appendix S, page 104: "It does not appear that suspended sediment concentrations will reach as high levels in the 50-70 m (160-230 ft) depth range of Smeaton Bay as they might in Boca de Quadra because Smeaton Bay is smaller and has only one deep outer sill. Smeaton Bay therefore communicates more freely with the Alaska coastal waters, so there is less chance of a build-up of suspended sediments in the surface waters." Tailing solids will be deposited below the outfall at 50 meters. The bulk of the tailings discharge into Rupert Inlet, Vancouver Island, British Columbia from the Island Copper Mine into a relatively shallow dynamic fjord over a 15 year period has not shown evidence of suspended tailings affecting fish and shell

244

#2 cont.

fish or their food sources. This should be noted in this item.

2. "The active deposition area for mill tailings would be below approximately 150 m."

#3

Active deposition of tailings will start below the 50 meter outfall in both basins and flow to deeper portions of the basins. To indicate that the active deposition area will be below 150 meters (m) is misleading. The major portion of the tailings will however be in the deeper portions of the basins. This is true for both Boca de Quadra and Smeaton Bay/Wilson Arm and should be noted. It should also be noted that the maximum depth of deposition in Boca de Quadra is less than 100 m more than in Wilson Arm/Smeaton Bay as shown on Table 3-7 (390 m versus 295 m).

3. "There is little opportunity for the discharge to reach and therefore potentially affect productive estuarine habitat at river mouths, an area of particular important to juvenile fish." (sic)

   Tailings discharge at the Island Copper Mine into Rupert Inlet at 50 meters has not impacted the estuarine habitat at the river mouth during more than 15 years of operation. Although extremely unlikely, such impacts would be predictable long in advance of any significant impact and could be mitigated by relocating the outfall further down fjord.

4. "There is almost certain contaminant of the discharge in a single basin."

#4

The word "contaminant" should read as "containment". Further, the point is insignificant since the NMFS has stated that the minor amount of tailings which potentially could enter Behm Canal would have no adverse impact. Additionally, any tailings in Behm Canal would be undetectable from the heavy sediment loadings contributed by the Chickamin River.

5. "A deep discharge is possible which provides increased protection from copper and other metal toxicity in the upper 100 m of the water column. This data suggests that we could see acutely toxic levels of copper in the water column as a result of the discharge."

#5

EPA's suggestion is contradicted by their statement on page 115 of Appendix S.

"Thus dissolved metals except perhaps mercury should comply with federal water quality criteria and state water quality standards at 100 meters. Mercury is also likely to comply since conservative assumptions are used in these calculations."

EPA's suggestion also creates the misleading implication that the surmised problem would be minimized in the larger Boca de Quadra fjord.

In actuality the very small area in which there is even a remote chance of a problem occurring, is the same in either fjord. The 2.19 to 11.87 ppb of copper used as an example is the concentration at the point where the tailings discharge into the fjord waters. The numbers used by EPA are also a very conservative interpretation of the data. Within 100 meters of this point (in either fjord and in any direction) the discharge will be diluted 10 fold at a minimum. The 2.19 and 11.87 ppb therefore becomes at least 0.219 and 1.187 ppb which is well below the water quality criteria. EPA also fails to note the fact that the initial dilution in the mixing tank is not fixed at 1:1 tailings to seawater by weight as assumed in calculating the 2.19 and 11.87 values in the first place. As noted in several places in this RDEIS (e.g. page A-39 or 2-6) the initial mixing chamber dilution can be as much as 1:4 tailings to seawater by weight which would lower the metals concentration at the end of the discharge pipe even more. Further, the lower copper value (2.19 ppb) is from the latest pilot plant test work which more closely represents what the level would be in actual operation. This fact should be noted and used in the evaluation.

EPA then compounds the misdirection by omitting their own qualifying statements.

As stated in this item;

> "The EPA evaluation also shows that heavy metals lead, mercury, and nickel could exceed EPA criteria and be toxic either individually or synergistically". Unfortunately, the EPA comment neglected to include the phrase "assuming no subsequent dilution" from their text (Appendix S, page 115). EPA further states (Appendix S, page 115) that ..."Thus dissolved metals except perhaps mercury should comply with federal water quality criteria and state water quality standards at 100 meters. Mercury is also likely to comply since conservative assumptions are used in these calculations."

#5 cont.

#5 cont.

It should also be noted that the EPA "Ambient Water Quality Criteria for Copper - 1984" published in January, 1985 (EPA-440/5-84-031) by the Office of Water Regulations and Standards, Criteria and Standards Division has a final acute value of 5.832 ug/l and a final chronic value of 2.916 ug/l for copper (page 57). For some unknown reason, the EPA publication of the "Water Quality Criteria: Availability of Documents: Notice" in 50 FR 30790, July 29, 1985 has applied the 2.9 ug Cu/l criterion maximum concentration (CMC) (Chronic toxicity) as the criterion continuous concentration (CCC) (acute toxicity). It appears that EPA must have mixed the CCC and CMC levels in their supporting document and have applied the chronic toxicity value of 2.9 ug Cu/l as the acute toxicity (CCC) "Ambient Water Quality Criteria for Copper - 1984" document.

6. "Allowing discharge to Boca de Quadra would result in some terrestrial, visual, noise, and marine impacts in a second drainage basin in the Misty Fjords National Monument. Additionally, the tunnel portal and related facilities occupying approximately 25 acres would be within the Wilderness boundary."

#6

Inasmuch as two of the prime arguments in the early stages of the project were to avoid impacting more than one basin and avoid impacting the Wilderness areas, these points are still valid and should be given proper consideration.

WILSON ARM/SMEATON BAY

#7

1. "...mill tailings could accumulate at or above the 100 m depth ...". As we have noted previously to EPA, if this is determined to be a problem at some point in the project life, the discharge outfall can be relocated down the tailings slope.

#8

3. "... there is less opportunity for dilution of potentially toxic metal concentrations and thus higher potential for impacts within the upper 100 m of the water column." This statement appears to be contradicted on page 64 of EPA's Appendix S where, in discussing circulation at the end of the project life, it is stated; "Smeaton Bay therefor communicates more freely with the Alaskan coastal waters, so there is less chance of a build-up of suspended solids in the surface waters." It appears reasonable to assume that the concentration of toxic contaminants would react in a similar manner. Again, in the discussion on

244

#8 Cont.

suspended solids advection from Smeaton Bay (Appendix S, page 63), "...transport of fines out of Smeaton Bay into Behm Canal is projected to occur at concentrations of 2-20 mg/1." This would indicate that outflow waters above the Smeaton Bay sill are carrying the fines. If the outflow waters above the sill are carrying fines, then it will certainly move dissolved potentially toxic metals out of the basin before the metals reach the upper 100 meter, especially since the sill is at 130 meter depth.

PAGE 1-2, para 4

#9

There should be an explanation early on in the RDEIS that EPA is not required to make an ocean discharge criteria evaluation in compliance with Section 403 of the Clean Water Act. It is merely used as a guideline in developing a Best Professional Judgment evaluation and places no legal bounds on EPA's permit process for this project.

PAGE 2-45, para 5

#10

The paragraph on Wharf Upfjord on Wilson Arm is not correct. This alternative required a major area to be filled into Wilson Arm to reach the necessary draft for the barges.

PAGE 2-46, table 2-3

#11

Costs presented in this table for water supply have been updated with the most recent analysis given in reference (U.S. Borax & Chemical Corporation 1985 h).

Section 2.7

Comments on this section are addressed in a separate letter to the U.S. Forest Service.

Page 2-52, para 3

#12

The question of containment of tailings in Smeaton Bay has little relevance to the issues of resuspension of tailings affecting the estuarine habitat. There is no reason to believe that tailings would have a greater resuspension potential due to the estuarine circulation expected at the end of the project. In fact, the relatively high current velocities in the deep basins during deep water renewal periods would have more resuspension potential.

244

PAGE 3-66, first line

#13

"...pink and chum salmon could support a substantial sport fishery in local rivers and fjords, but are under utilized because the fishery in the Ketchikan area meets current demand..."

Very little sport fishing for chum salmon occurs in the Ketchikan area. It is not likely that the project area would be utilized for sport fishing for these species.

PAGE 3-69, para 3

#14

The citing of Schmidt et al., 1977 for subjectively rating Blossom, Wilson, and Keta Rivers for having the best rearing potential is outdated for this RDEIS. The document was a proposal written prior to any baseline work and was based on minimum observations of these systems. The determination of the best rearing potential should be based upon the data developed during the extensive baseline studies which followed the Schmidt proposal.

PAGE 4-28, Last Sentence

#15

An in-depth understanding of the geology of the ore and waste rock, based on extensive coring, surface mapping, petrographic examinations and chemical analyses, show that the acid-producing characteristics of samples tested are equally representative of the waste rock. Further, waste rock testing has indicated there will be no significant problem. U.S. Borax has committed to preparing a waste disposal plan prior to operations which would include blending acid producing and acid consuming rocks to minimize any unforseen problems.

PAGE 4-45, para 2

#16

It should be noted that the plume of fines has a very low suspended solids concentration. For instance, at Island Copper the suspended solids concentration drops to 20 mg/1, 25 meters above the bottom at 300 meters downstream of the outfall, and below 20 mg/1 at 12 meters above the bottom 1000 meters downstream of the outfall.

PAGE 4-58 para 3 through bullets

#17

Three simultaneous events are required before tailings fines could reach the surface waters.

#17 cont.

1. low water column density stratification which sometimes occurs in the early spring;

2. a standing crop of suspended fines in the deep basin water which would generally occur in late summer due to the summer renewal process;

3. one of the mechanisms mentioned in the text that would produce sufficient energy to move the deep water mass to the surface.

This section should be clarified by noting that the probability of these three events occurring simultaneously is low and therefore the probability of tailings fines reaching the surface waters is also low.

#18

PAGE 4-72, para 1

The "assumption" that 600 mg/l should be the fines concentration used to represent the "bottom" concentration for the circulation model is incorrect. The concentration used in the model was 0.02 g/l or 20 mg/l (Kowalik 1984, p. 52 and Kowalik and Findikakis 1985, p. 61), which represents the concentration at the top of the density current.

The assumed 600 mg/l concentration is within the density current flow. It is inappropriate to base an assumed surface level on this value.

#19

PAGE 4-72,para 4 and 5

Bullet 3 references Kowalik and Findikakis, 1985, p.67 as the source of the assumption that tailings concentration above the sill ranges from 0.6 to 6 mg/l in order to generate the conclusion (alarming to the average reader) that 245,000 to 576,000 tons per year of tailings will enter Behm Canal. This deduction is not only inappropriate in intent, it is also completely false. In the first place the referenced page in the document is a figure (Figure 23(e) and (f) which shows the 1% and 10% contour lines of the bottom suspended sediment load (20 mg/l). As noted on page 68 of this reference the maximum amount that goes past the sill is the 1 % contour. The 10% contour is noted as only reaching within 1 KM of the sill. As noted on page 68, the maximum amount going over the sill is 2 mg/l even if it is assumed that the 10% contour ever reaches the sill. The referenced figure therefore indicates the maximum material which could possibly go over the sill is 0.2 mg/l to less than 2 mg/l. Secondly, the assumption is

#19 cont.

made that the current velocities act over the entire 60 to 120 m depth noted in bullet 1. This is an erroneous assumption since the high current velocities occur only near the bottom. As noted on the same page of the same reference of bullet 2 (Nebert 1985. p.12), "... the deep current meters on the sill (117 and 148 m) show a net outflow of 5-12 cm/sec." The same reference then goes on to say "the two upper current meters (37 and 58 m) show variable flow direction, with a possible net inflow in the 37 m instrument...". Thirdly, no attempt is made to do a similar calculation for tailings which would flow over the Kite Island sill into the outer basin of Boca de Quadra although the currents are of higher velocity than they are on the Smeaton Bay sill.

Further, Figure 4-7b, p.4-57 (Boca de Quadra) and Figure 4-13, p.4-71 (Smeaton Bay) show very similar distributions for the percent of fines at the sill. It is suggested that fine tailings going into the outer basin of Boca de Quadra could have environmental impacts similar to those with fines in Behm Canal.

#20

PAGE 4-88, para 1

"...indicates that at pH = 8 hazardous concentrations of H_2S may occur in the near field zone and tailings turbidity plume;..."

The purpose of the Nokes reagent and the generation of hydrosulfide during the flotation process is to depress the trace metals such as copper, lead, zinc, etc. by the formation of the respective insoluble sulfides. The developed hydrosulfide is used up during the depression process and only that minor amount which is not used will be discharged. Therefore, to state that hazardous concentrations of hydrogen sulfide may be present in the near field zone and tailings turbidity plume is erroneous.

#21

PAGE 4-89, para 1

Data from benthic surveys of the AMAX Kitsault tailings in Alice Arm, B.C. show that the benthic organisms are recolonizing at a rapid rate within one year of ceasing discharge of tailings. Similarly, recolonization studies by Dr. D.V. Ellis of the University of Victoria in Rupert Inlet indicate recolonization occurs within a year depending on the season. In addition, the baseline studies on benthic organisms in Alice Arm, B.C. which was done two years after B.C. Moly ceased discharge of tailings showed

#21 Cont.

that the benthic community had recovered. The RDEIS statements should be qualified.

PAGE 4-104, para 4

#22

Based on actual experience, the scenario presented in this paragraph is not likely to occur in any catastrophic event.

During the fall of 1978, a natural landslide totally blocked Hill Creek followed by a release of sediment and debris to the Keta River. The amount of debris was significant as it changed the configuration of Hill Creek at its confluence with the Keta River. This natural occurrence did not destroy the incubating eggs in the Keta River and did not affect the production of the various species below the confluence as noted by the escapement records.

PAGE 4-130, para 3

#23

The data obtained on the toxicity of M502 are based on similar quaternary ammonium compounds with different hydrocarbon chain lengths. Because the toxicity of these compounds is not a function of chain length, shown by studies of salts of varying chain lengths, there is no reason to believe that additional toxicity would be expected from M502. In addition, M502 was shown to adsorb to particulates (its primary function as a flocculant) and be removed from solution. Acute tests with sediment present indicated a marked reduction in toxicity. This information, combined with the overall tailings toxicity data, provides ample information for this level of analysis. The very detailed data required by the footnote on this page is more appropriately obtained at a later stage of investigation.

PAGE 4-131, para 1

#24

It is difficult to rationalize EPA's present conclusion that the bioassays are flawed since John Armstrong of EPA Region X , and Joe Cummins and Carolyn Ganmark of EPA's Manchester laboratories were consulted heavily in the planning of the studies and concurred with the plan. The resulting series of studies were considered to be the best set possible given the circumstances. Except for a few minor bioassays on specific components of the tailings, such as certain reagents, further testing would not significantly improve the information base required to evaluate potential toxicity.

#24 Cont.

The results of bioassays conducted by EVS showed that the toxicity of the tailings was low in all cases studied. The crab zoea used in the study were stressed due to the time of year of the study and poor condition of the crabs resulting in high control mortalities. The implication in the text is that no tests were valid because of the control mortalities in the crab Zoea tests. Generally, control mortalities were well within acceptable ranges.

Exposure levels are always difficult to assess in sediment bioassays due to the inhomogeneous nature of the media. In discussions with the EPA in Seattle, it was agreed to conduct the studies without constant stirring in order to study the toxic effects of the tailings only, rather than confuse the results with physical smothering and abrasion from suspended particulates.

The critical point in the evaluation of potential tailings toxicity is the low toxicity noted in the studies. Given the circumstances in the real world of much lower aquatic exposure levels during operations, no toxic effects to organisms in the fjord systems is expected.

PAGE A -7

#25

Figure II - 1 does not show Boca de Quadra tailings disposal as discussed in Section II.

PAGE A-62

#26

Table II-10 should be consistent with Table C-2-4, page C-50.

PAGE A - 64, para 3

#27

The pipeline is erroneously noted as being buried. The above ground design presented on Sheet 14 of the Corps of Engineers Public Notice (Appendix P) is correct.

PAGE A - 96, para 3

#28

The average annual precipitation is 150 inches (page 3 - 1) not 190.

PAGE C - 8, para 2

#29

The major portions of the engineering values are taken verbatim from the August 1986 PSD and Air Quality Permit to Operate applications. They should be referenced instead of the 1983 application and 1984 responses to ADEC.

244

Q-200

PAGE C - 22

The tractor-trailer emission factors are based on a 5.4 mile round trip factor. The correct factor is 3.4 miles as used elsewhere. #30

PAGE C - 29

The area blasted given in Section 2.4.2 is in error (13870 holes per 365 days on 32x32 centers is 38,912 sq ft ^{2} per day, not 30,950 sq ft). #31

PAGE E-19, Last bullet

See Comment for Page 4-28, Last Sentence #32

APPENDIX F, general

The chemical oceanographic evaluation focuses on the dilution of the dissolved portion of the tailings in the near field, with the inclusion of the hypothetical "Total Recoverable Concentrations," based on sediment load and metal concentrations contained in the sediment. Obviously, where the suspended sediment concentrations are high, calculated "Total Recoverable Concentrations" will be high because sediment mineral concentrations are generally two to four orders of magnitude higher than ambient seawater. It is inappropriate to consider dissolved and "Total Recoverable Concentrations" within the density current, especially in the near field, due to the fact that the density current is not an appropriate habitat for marine organisms. Further downstream in areas removed from the active transport system where organisms could survive, is the appropriate area to consider the impact of toxic components of the tailings. #33

PAGE F-7, para 2

The analysis presented here and elsewhere in the RDEIS is extremely conservative in that the concentrations in the tailings liquid phase were conservatively estimated, sometimes by an order of magnitude; the dilution in the mixing chamber was conservatively estimated, possibly by a factor of 4; and the near field dilutions were also conservatively estimated. Even with these conservative estimates, water quality standards are met except for the few cases noted. #34

244

PAGE F-7, last paragraph

#35

This discussion is based on calculated "biologically available" metal content of the tailings solids times the concentration of solids. The origin of the "extractable" value or the value of suspended solids is not clear from the discussion. The concept of Total Recoverable Metals is not well defined in the context of tailings disposal with density current transport from the outfall into the deep basin. The EPA is attempting to generate a consistent data set to evaluate the biologically available metal content based on a fraction that is soluble at a pH of approximately 4 because it is believed that the gut pH of many organisms is at that level and therefore metals would be extracted by the organism at that pH. This concept has been questioned in recent years, even by people within the EPA, as being an oversimplification. No acceptable procedure has been approved by the EPA to simulate this fraction of the contained metals, so a fall back, total recoverable metals, has been adopted. This method entails the vigorous digestion of the sediment using nitric or nitric and hydrochloric acids at 90 degrees C which extracts all but the lattice metals from coarse grain sediments and can literally dissolve the mineral content of very fine grain material. This is clearly not representative of the biologically available fraction of sediment metals in seawater.

The data used to develop the ambient water quality criteria used dissolved data for nearly all studies, and very few of the studies involved any suspended solids. None of these studies utilized solids concentrations in the range evaluated here for the near field. Considering the environment that an organism would experience in the near field density current and the gross uncertainties of the "total recoverable concentrations" illustrated here, this analysis is not appropriate for evaluating toxic impacts of the tailings. This type of analysis may have some value in the far field where suspended sediment levels are in a concentration range where organisms could exist, but even there, major uncertainties exist regarding suspended solids concentrations, bioavailability of metals, etc. The most valid evaluation would utilize existing data from other tailings discharges, for instance Island Copper, where little toxicity has been seen in the deep basin.

Finally, the greatest hazard to life at the center of the density current at 100 meters from the outfall is the physical smothering and abrasion expected from the high concentration of moving sediment and not toxic impacts of

heavy metals having the same magnitude of metals concentration as natural sediments. #35 cont.

APPENDIX G, Section 12

#36 This entire discussion appears to be directed at proving that the bioassay studies conducted by EVS Consultants are flawed and that conclusions cannot be drawn from the information. In fact the data indicate that the tailings exhibit very low toxicity, in suspension or deposited on the bottom, to a wide range of organisms utilizing varied habitats and feeding strategies. Further, the data indicate that there would not be toxic concentrations anywhere in the fjord systems except directly in the path of the density current within a few meters of the outfall. There is no evidence that toxic impacts would result from tailings discharge to the fjord.

#37 Your attention is also directed to the fact that EPA was itself involved in designing the bioassay studies with EVS Consultants as was noted in our comments for page 4-131, Para. 1 and G-44, Para 1.

PAGE G-39, Para 3

#38 "Additional information ...needs to be obtained... NPDES permit." Our comment to page 4-130, para 3 applies. Further, EPA has stated they will require testing of all new reagents prior to use.

PAGE G-43, last para

#39 The discussion of the Greenex situation is not relevant to Quartz Hill tailings disposal because the mineral components of the ore are very different with very different leaching chemistries.

PAGE G-44, para 1

#40 It is not the opinion of U.S. Borax, EVS Consultants, John Armstrong, or Joe Cummins of EPA Region X that there were methodological flaws in the bioassay studies. The studies were designed to let suspended solids settle out during the tests to obtain information on chemical toxicity rather than the physical smothering and abrasion to which species caught in the density current would be subjected. Control survival was above 94% in all acute tests and well above standards for all but the crab zoea tests in the chronic bioassays.

PAGE G-44, para 3

#41 The discussion here of inaccuracies in data reporting result from a misunderstanding of the data itself. No one is trying to make one believe that the concentration of solids in the test containers had a certain amount of suspended tailings throughout the test period. The tailings slurry was added and mixed at the beginning of the test and allowed to settle. This was done to separate out effects of chemical toxicity from that of abrasion and smothering which would be certain at the high suspended solids concentration. Tests with burrowing organisms were also used to evaluate the effect of the solids. This concept was utilized throughout the studies.

PAGE G-46, para 2

#42 "A paucity of information is available on tailings from other similar operations as well."

This is a completely inappropriate statement in light of the voluminous data collected at Island Copper in over 15 years of similar operation as well as data from other marine disposal facilities around the world.

PAGE G-46, para 3

#43 The high mortality rates with crab zoea were due to poor timing of the tests when crab were past their normal spawning period and were therefore in poor spawning condition. The poor control survival was recognized. This poor crab zoea control survival in no way influences the validity of the many other tests conducted.

PAGE G-49, para 2

#44 The metal levels in the tailings are not elevated above natural sediment concentrations in Boca de Quadra. Table F-6 illustrates the relationship of extractable metal concentrations of metals from tailings and natural sediment, indicating that in all cases except molybdenum, the natural sediment concentrations are higher. This may explain why organisms do not bioaccumulate additional levels of metals from the tailings.

PAGE G-50

#45 "More ...information... on the bioaccumulation potential... reagents." See comment on Page 4 - 130, para 3.

APPENDIX S, Page vi

This page lists seven reasons for the selection of the middle basin of Boca de Quadra as having the least biological impact from tailings disposal. These points are nearly 100% verbatim from EPA's Ocean Discharge Criteria Evaluation issued in October 1985. These points were extensively commented on at that time by Rescan Environmental Services who noted significant flaws with all seven points. EPA has yet to respond to these and other comments made by Rescan. This despite the fact that the comments were the result of reviews by internationally known scientists with far more experience than EPA in the biological effects of tailings disposal. It is inconceivable to us that these comments could be ignored. Inasmuch as the seven points (see pages xv and xvi of this RDEIS) are the same, the comments made on them by Rescan are still valid and are incorporated by reference into this letter of comment (U.S. Borax letter and report to EPA, November 1, 1985).

The following additional comments are made on the seven reasons:

#46

Bullet 2 - The point refers to tailings being..."forced to spill over the dynamic area of the inner sill." Smeaton Bay does not have an inner sill. It should be noted that this portion does not apply to Smeaton Bay.

#47

Bullet 3 - In comparing Boca de Quadra middle basin discharge to Smeaton Bay discharge the difference in area covered is hardly significant, 1600 hectares versus 1660 hectares. The statement should be qualified.

APPENDIX S, Page 2

#48

The reason for this evaluation is U.S. Borax's submittal of an NPDES application for discharge of tailings to Wilson Arm. This application supersedes an earlier application for discharge to Boca de Quadra. This is not at all clear from the third paragraph of the section, Project Overview and Scope of Evaluation which is written to imply that EPA is considering not one but two different applications at the same time. It should be clearly stated at the beginning of this appendix that the evaluation was made in response to U.S. Borax's application for an NPDES permit to discharge tailings to Wilson Arm/Smeaton Bay. Any other discharge point is only an alternate considered in the evaluation of the application.

#49

Further, the purpose of this evaluation of the application for an NPDES permit is to determine whether "unreasonable degradation" will occur with the proposed discharge. If no such degradation exists, EPA can issue the permit. If unreasonable degradation cannot be determined, EPA may still issue the permit if it is determined there will be no irreparable harm during a period of monitoring.

The Environmental Protection Agency has made its best professional judgement and found that no unreasonable degradation of the marine environment from tailings disposal into Smeaton Bay/Wilson Arm will occur. Therefore, EPA is in the position of being able to issue an NPDES permit for tailings disposal in Wilson Arm/Smeaton Bay.

APPENDIX S, page 62, para 1

#50

This paragraph purports to indicate that suspended solids could reach 0.2 to 2 mg/l in the upper 60 m of Smeaton Bay, the implication being that this material could then move into Behm Canal. This paragraph is totally misleading and is even contradicted by EPA itself. The concentration of fines at 60 m given here is high by 1-2 orders of magnitude. Paragraph 5 on page 39 clearly states that the suspended fines are 5-10 mg/l at the top of the cloud near the bottom. If this is the case, there would seem to be no justification whatever for EPA to use the 200-2000 mg/l concentration in the tailings cloud at the bottom of the fjord. The correct concentration in the upper 60 m is 0.1 to 1 percent of 5-10 mg/l or .005 to 0.1 mg/l. EPA presents a picture of large quantities of fines going into Behm Canal but this is of little consequence in light of the National Marine Fisheries Service conclusion that;

> "... additions to the flow of sediments along the bottom of Behm Canal resulting from the discharge of mine tailings into Wilson Arm would not likely result in a discernible impact to the fisheries resources of Behm Canal." (Correspondence, National Marine Fisheries Service to John Paulsen, July 22, 1986).

APPENDIX S, Page 62, para 4

#51

The statement; "Filling the inner basin to a depth of 80 m (260 ft) would place the more dense turbidity zones within the seasonal range of the pycnocline" is incorrect and misleading. The filling of the inner basin to a depth of 80 m will certainly change the circulation and thus the

244

#51 cont.

pycnocline. The pycnocline depth used in the analysis is applicable only when the basin is in its current state.

APPENDIX S, Page 80, para 3

#52

The last sentence states the deep water habitat will be replaced by shallow habitat. This is incorrect. The 100 to 200 m depth resulting is a mid-depth habitat.

APPENDIX S, Page 80, para 4

#53

Bullet 2. This statement compares the risks of biological effects between inner and middle basins of Boca de Quadra. This doesn't make sense as the pycnocline will change when the inner basin is filled and the turbidity current developed by the tailings discharge will flow into the middle basin. The sill will no longer be a high energy area except for the turbidity current.

#54

Bullet 3. This statement again compares the inner and middle basins of Boca de Quadra. The total area difference between middle basin Boca de Quadra and Wilson Arm/Smeaton Bay is minimal.

#55

Bullet 4. The argument on the source of spawn for recolonization is not valid as all systems have upfjord and downfjord sources.

#56

Bullet 5. Impacts on estuarine habitats are very unlikely with any of the discharge alternatives. The estuarine habitat of Rupert Inlet, Vancouver Island, British Columbia has not experienced any impacts on the estuarine habitat from the tailings disposal. Any such impacts would be detectable long before they became significant and could be mitigated by moving the outfall further down fjord.

#57

Bullet 6. We agree, the bathymetry of the three basins will change with the middle basin discharge being least altered. However, the other basins will be predominately shallow and middle depth basins and these are generally considered to be more productive than deep basins.

APPENDIX S, page 81, para 2

#58

"Available information ... is insufficient...". Please see comment made on Page 4 - 130, para 3.

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APPENDIX S, page 86, para 4

#59

Absorption of metals through the gut of most organisms is controlled by the same chemical mechanisms as the solubilization of the metals from sediments. The actual effect of the gut pH on uptake of metals is quite debatable at this time. The long-term studies conducted by EVS on actual tailing solids, with real organisms did not indicate any appreciable uptake, even in Mytilus edulis, a species used in monitoring because of its known propensity for bioaccumulation. Therefore, the data show that there was no significant bioaccumulation of the metals studied from Quartz Hill tailing.

APPENDIX S, page 87, para 4

#60

"Bioaccumulation of water soluble hydrocarbons may occur particularly with tailings discharge to Smeaton Bay." We cannot ascertain why this is perceived to be a problem in Smeaton Bay and not Boca de Quadra since the same material and quantity would be discharging in either location. It should also be noted that with a Boca de Quadra discharge there would be hydrocarbons in both fjords since surface runoff would still go to Wilson Arm/Smeaton Bay.

APPENDIX S, page 115

#61

In the first full paragraph it is stated: "The comparison of dissolved metals concentrations expected in Quartz Hill discharge to EPA criteria indicates that copper, lead, mercury, and nickel could exceed EPA criteria assuming no subsequent dilution." This statement is misleading in that it ignores two important factors; 1) A 1:2 tailings to seawater ratio by volume (equivalent to a 1:1 ratio by weight) is assumed although U.S. Borax has repeatedly indicated this ratio can be 1:4 tailings to seawater by weight (equivalent to a 1:8 ratio by volume) and could even be more, and 2) The statement (at a 1:2 ratio) is correct only at the end of the discharge pipe and fails to mention that dilution begins immediately.

The information is misleading because it is based on overly conservative assumptions. Only the highest values of Table 2-3 on page 5-15 are considered. This in spite of the fact that footnote (C) of Table 2-3 clearly states that the pilot plant data are more representative of actual plant operations. Based on the more realistic values, only mercury remains above EPA's criteria (without the additional dilution that occurs naturally and immediately) and then only marginally.

6/29/87
JCP:gw

244

USBORAX

June 29, 1987

U.S. Army Corps of Engineers
Alaska District, Regulatory Branch
P.O. Box 898
Anchorage, Alaska 99506

Attention: Mr. Gene V. Augustine

Subject: Ref. No. 071-OYD-2-840015
Public Notice of Application and
404 (b) (1) Evaluation

Dear Mr. Augustine:

On behalf of Pacific Coast Molybdenum Company, U.S. Borax is pleased to respond to the Corps of Engineers' request for comments on the subject documents. The two documents are a part of the Revised Draft Environmental Impact Statement upon which we have commented in separate letters. We have no substantive comments on either the Public Notice or the Evaluation since they reflect our proposed project as modified for a Wilson Arm/Smeaton Bay tailings discharge. Should the Final EIS determination differ from the current application, a revised application for permit may be necessary.

Please do not hesitate to call either Ken Reim, Don Finney or the writer if you have any questions.

Sincerely,

C. A. Hesse
Vice President & Project Manager
Quartz Hill

CAH:ems

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cc: Mr. Win Green
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Attention: Mr. Robert S. Burd, Director
Water Division

Office of Management & Budget
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Attention: Mr. Robert Grogan, Director

UNITED STATES BORAX & CHEMICAL CORPORATION • 3075 WILSHIRE BOULEVARD • LOS ANGELES, CA 90010-1884 • (213) 381-5311
MAIL ADDRESS P.O. BOX 75128, SANFORD STATION, LOS ANGELES, CA 90075-0128

722 Park Avenue
Ketchikan Alaska 99901
June 30, 1987

Win Green
Forest Supervisor
Tongass National Forest
Ketchikan Area
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

I would like to make the following comment regarding the draft EIS for the Quartz Hill molybdenum project mine development.

I agree with the Environmental Protection Agency preferred alternative for tailings disposal because tailings disposal in the middle basin of Boca de Quadra will probably result in less harm to the fishery resources of that area than tailings disposal in Wilson Arm.

If indeed the bottom line is dollars, what justification is there for the Quartz Hill molybdenum mine to develop an area that is a major contributor to an already existent industry in S.E. Alaska - the salmon industry? #1

The salmon industry in Alaska is recognized as a major source of jobs and income for many residents and non-residents of Alaska. Protecting and enhancing those areas that directly contribute to the salmon fishing industry seems to be the most logical step to ensuring the continued growth and well being of this industry in S.E. Alaska.

In conclusion, I support the use of the middle basin of Boca de Quadra for tailings disposal from the Quartz Hill molybdenum project mine development.

Thank you for this opportunity to comment.

Deidra Holum

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KETCHIKAN DAILY NEWS * PIONEER PRINTING * MEMO

..........from the desk of Lew Williams, Jr.

Note:

Consider the editorial from our June 16, 1987 edition as our comment on the draft EIS for U.S. Borax's Quartz Hill project.

L. M. Williams Jr.
Publisher

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Ketchikan Daily News
June 14, 1987

Editorial

Due soon

In two weeks the comment period ends for the draft envirnmental impact statement for U.S. Borax's Quartz Hill project. More than 100 comments have been made to the Forest Service office in Ketchikan in the month that comment has been open. All but a half dozen comments have favored the Forest Service alternative to allow tailings disposal in Wilson Arm.

The main concern in debate over the impact of the mine operation is tailings disposal in Wilson Arm may affect fisheries. So far, Borax's operation — building an access road and taking out a bulk sample of the ore — has had no effect on fisheries or fishery habitat. There won't be a negative impact on fisheries or fish habitat, according to law. It's all laid out in Section 505 (a) (b) (c) and (d) of the Alaska National Interest Lands Conservation Act of 1980.

Under terms of that section, the Secretary of Agriculture cooperates with the state to assure the mining operation is conducted without damage to fisheries or fish habitat. In the event there is damage, the secretary is required to shut down the operation for seven days, during which time he can go to U.S. District Court for an injunction stopping operations.

That's a strong stand in support of fisheries and it's the law, not just a policy or a promise.

Therefore, Borax should be allowed to go ahead with tailings disposal in Wilson Arm, as the company officials desire. They are required to do the job right or suffer the consequences, which we are sure the state Fish and Game department will cause the secretary to invoke if damage is found. The law says the state retains control over fisheries.

More important immediately is for those who favor the project to send in a letter of support. In the letter, cite a specific effect or reason why the writer believes the project should be allowed to move ahead.

After suffering the collapse of oil prices, Alaskans swore to diversify the state's economy. One way to do that is to develop the hard rock minerals in Alaska. Quartz Hill is a major part of such development and should move along promptly.

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June 30, 1987

USDA-FOREST SERVICE
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	INIT	ACT.	INFO	DATE
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Mr. Ed Johnson
U.S. Forest Service
Federal Building
Ketchikan, Ak. 99901

Has the Forest Service completely lost its perspective? Why would they even think of reversing a decision just because Borax demands it? The EPA has not given in to Borax's bullying. The EPA opposes any tailing dumping in Wilson Arm and so should the Forest Service.

There should also not be any draining of supplemental water from the Blossom River or construction of a dam system which sould impede fish movement.

A well field for water in the valuable Wilson River is obviously not acceptable.

The entire project should never have gotten approval in the first place. The Forest Service is suppose to be managing public lands for multiple use and protection of fish, wildlife and recrestion resources for long term austainability. The Forest Service should be spending its time trying to reduce impact on the National Monument rather than trying to reduce Borax's cost.

Has the Forest Service investigated Rio Tinto Inc. to see houw their past operations at other mining sites have affected the surrounding region? "River of Tears" would be a very interesting book to read for anyone who is listening to Borax make its empty promises.

Let us not be swept off our feet by a British Empire mining conglomerate who would like to reduce the cost of ore mining here to that of a third world country. Alaska may be a long way from the United States, but one would hope that our officials here were sophisticated enough to investigate the long term problems of this budding relationship.

Please let us keep our heads and wits about us and not be forced into a decision now that we will certaintly regret later just because of manipulations from a very large and powerfull company with its own finscial profit as its main concern.

Sincerely,

Sy Painter

Sy Painter
P.O.Box 6181
Ketchikan, AK 99901

cc: Governor Steve Cowper
Robert,Burd, Director Water Division, Region X
Col. Wilbur Gregory, District Engineer Corps of Engineers

Q-207

248

Randy & Jill Dobrydnia
Box 653
Ward Cove, Alaska 99928

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TONGASS NF
KETCHIKAN, AK 99901

Mr. Win Green, Forest Supervisor
Foreet Service
U. S. Dept. of Agriculture
Federal Building
Ketchikan, Alaeka 99901

Dear Mr. Green,

We are writing to voice our objection to U. S. Borax/Quartz Hill Mine proposal to dump tailinge into Wilson Arm/Smeaton Bay. We are quite amazed that this proposal is even being considered. During the preperation of the draft E.I.S., the public showed, overwhelmingly, they preferred Boca de Quadra ae a tailings disposal site and the Forest Service agreed. Now that the final E.I.S. is being prepared, Borax is trying to slip in their original plan to use Smeaton Bay.

We believe environmental controle ehould be reaeonable, but should not overlook protection for our future generations use, not just immediate usage. Perhaps our children and grandchildren will realize the value of wildernees for what it is and not juet for what lies beneath the ground. In which case, we could all be remembered for the preservation of Smeaton Bay rather than for its destruction. Lowering the controls to allow tailinge in Smeaton Bay just to save Borax a few dollars ie just a eellout of our wilderness and fisheries. Spending a bit more to put tailings in Boca de Quadra should certainly allow Borax to still make ample profits. Possibly destroying such a pristine, bountiful inlet ae Smeaton Bay all for the sake of money, displays man's greed for what it really ie; deetructful. We don't believe Borax will forego opening the mine if required to use Boca de Quadra for tailings disposal.

Smeaton Bay ie not only one of the major salmon producing areae in Southeaet, but also many species of trout, dungeness and tanner crab, shrimp, seals, black and brown bear, and nesting grounds for innumerable species of waterfowl. How could money ever be considered a fair replacement for such ri hes? All the money in the world could not return Smeaton Bay to the way it is today, if destroyed.

We have visited most of the bays in Misty Fiords National Monument and coneider ourselves quite lucky. To witness such a place so untouched by man allows one to contemplate life's purpose and to step back out of the maddening pace of today's life. To find such a large exranse of wilderness is almost impossible.

But that's not the way it will be. Some day Quartz Hill will no longer exist and future generations will wonder what changed the shape of the land so dramaticly. It would truly be a disservice to ourselves and future generations to allow the inevitable change, and possible destruction, that would take place with the use of Smeaton Bay and Wilson Arm for tailings disposal all for the sake of U. S. Borax getting to put more money into their pockets.

We urge the Forest Service to require U. S. Borax to use Boca de Quadra for tailings disposal.

Sincerely,
Jill and Randy Dobrydnia

copies to:
Mr. Robert Burd, Environmental Protection Agency
Col. Wilbur Gregory, U.S. Army Corps of Engineers
Mr. Bob Grogan, Division of Governmental Coordination

PEI Consultants, Inc.
Consulting Engineers and Surveyors
1225 Tongass Ave., Ketchikan, AK 99901 (907) 225-6626

June 30, 1987

Mr. Win Green, Forest Supervisor
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

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KETCHIKAN AREA
JUL 1 1987
TONGASS NF
KETCHIKAN, AK 99901

Re: Quartz Hill Molybdenum Project
Draft Environmental Impact Statement

Dear Mr. Green:

I am writing to you in support of the development of the Quartz Hill Molybdenum Project. I speak to you from the perspective of being a fourteen year resident of Southeast Alaska, manager of the Bulk Sample Road Design, and an avid recreational boater.

I fully support the Forest Service Preferred Alternative in the Draft EIS with the Tunnel Creek mill site and the tailings disposal to Wilson Arm. From the massive amount of data, this appears to clearly be the most environmentally balanced and economically viable plan.

#1 Conversely, I feel the EPA Preferred Alternative which requires disposal of the tailings in the middle basin of Boca de Quadra lacks the environmental data to justify the significant additional development and operating cost. It is imperative for this mine to be as cost effective as possible so as to have a strong position in the world market. This would provide the greatest measure of stability to our community.

I am convinced that responsible development of the Quartz Hill Mine will be of significant benefit to not only our community of Ketchikan, but to our State as well. Let me point out that while many of us support the development for the economic benefits it will bring, we are not anti-environment. Indeed those of who live, work and raise our families in this small, remote area of Alaska probably have a greater appreciation of the values of the Misty Fiords National Monument than those who only read about it or at best make a short visit. I am positive this mine will not be detrimental to the Monument nor provide significant environmental impacts.

Very truly yours,

PEI Consultants, Inc.

Ray Bloom

By: Ray Bloom
Vice President

cc: Robert Burd, Water Division
Col. William Gregory, District Engineer
Rob Grogan, Office of the Governor

cw/WD11

250

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EARTHGUARD SERVICES
by PETER I. SLABY
805 North 28th Street
Milwaukee, Wisconsin 53208
(414) 342-1735

DEFENDING PLANET EARTH BY:
RESEARCHING
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Saturday
27 June '87

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Edward P. Johnson,
U.S.F.S. Fed. Bldg.
Ketchican, Alaska 99901

Dear Mr. Johnson,

I recently returned from an out of state trip to find, amongst my pile of mail, the latest Sierra Club report on Alaska ANILCA issues. RE: Quartz Hill mine, with time so short, here are some of my concerns:

First of all, I have never visited South-east Alaska, tho it is on my lifetime agenda. My knowledge of Tongass Forest, misty fjords and Quartz Hill is based on what I have heard read and maps poured over.

As understood, BORAX and your Forest Service (and mine too!!) would like to dump the tailings in Wilson Arm because it is easier and cheaper. Boca de Quadra disposal site would add to the initial costs of mining. My map of Tongass Forest shows a sliver of water extending east from Behm Canal, Is this Wilson Arm fjord??

If Wilson Arm is environmentally fragile what with the salmon and other forms of life threatened, ... and Boca de Quadra is preferred by Environmental Protection Agency, Sierra Club and Alaska Coalition, then I FLAT OUT GIVE MY SUPPORT TO DISPOSAL OF TAILINGS IN BOCA de QUADRA.

Fifty years existence in this world has taught me the human species has a notorious tendency to think short term and disregard TOTAL long term costs to our fragile biosphere. In Milwaukee and Wisconsin, there are plenty of examples of groundwater contamination, waste disposal problems, lead contamination, Lake Michigan toxic problems, all of which ~~was~~ were not supposed to happen or nobody thought about, decades earlier. You have probably heard about advisories NOT to eat Lake Michigan fish. Now we have the word warning against eating certain ducks.

NO!!! I must demand my U.S. FOREST SERVICE review its past policy, and begin giving much greater weight to habitat protection and better estimating of TOTAL COSTS LONGTERM.

It will be a sad day if our future sons and daughters damn us if they must end up paying the ultimate bill.

Sincerely, Peter J. Slaby

PS. Please put me on the mailing list for any pertinent material re: TONGASS FOREST — THANKS.

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3509 HPR
Sitka, AK 99835
June 29, 1987

Forest Supervisor, Ketchikan Area
U.S.D.A. - Forest Service
Box 2278
Ketchikan, AK 99901

Re: Quartz Hill ES

Gentlemen:

I was disappointed that the impacts on the Misty Fords Wilderness resources were not seriously considered in the ES. Yes, you had a recreation journeyman review the literature and write something about wilderness. And yes, recreation is one of the resources allowed in wilderness. But there is no discussion of wilderness values or the wilderness resource as defined in the law — you could minimize a number of long-term impacts on the wilderness resources by having a wilderness specialist review, on-the-ground, the wilderness values and potential impacts — and this need not have any major impact on the mine or the industry.

I remind you that your oath-of-office requires you to defend the Constitution including the requirement to faithfully execute the laws — that is not being done for the wilderness provisions of ANILCA or the Wilderness Act.

#1

Sincerely
Dick Wilson

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KETCHIKAN AREA
JUL 2 1987
TONGASS NF
KETCHIKAN, AK 99901

251

Sunrise, Mt. McKinley   Ansel Adams

SIERRA CLUB
LEGAL DEFENSE FUND, INC.

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June 30, 1987

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Mr. Win Green
Forest Supervisor
U.S. Department of Agriculture, Forest Service
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

RE: Revised Draft Environmental Impact Statement for the Quartz Hill Molybdenum Project

Dear Mr. Green:

The Sierra Club Legal Defense Fund has reviewed the revised draft environmental impact statement for the Quartz Hill molybdenum project on behalf of the Southeast Alaska Conservation Council, the Sierra Club and The Wilderness Society. As set forth in detail below, we have found substantial deficiencies in it. These include its recommendations that mill tailings be discharged into Wilson Arm and that Wilson River be used as a water supply source; its failure to discuss adequately mitigation measures, a reclamation bond and potential violations of federal mining regulations; its failure to discuss the environmental impacts of an intertie and log transfer facility; its treatment of the mine and power plant sites as nonadjacent or noncontiguous properties; and its failure to apply the ocean discharge elimination criteria to the marine disposal of tailings.

I. *THE TAILINGS DISPOSAL PROVISIONS OF THE REVISED DRAFT EIS ARE INVALID*

A. *Submarine Disposal Violates Substantive Provisions in ANILCA*

#1

As noted in our comments to the first Quartz Hill draft environmental impact statement, we believe that the marine disposal of mill tailings violates subsections 505(a) and 505(b)(3) of ANILCA. These provisions establish strict requirements for the protection of fisheries. Section 505(b)(3) requires that the Secretary both

"maintain[ ] present and continued productivity of the habitat of anadromous fish and other foodfish," § 503(b)(3)(B), and "prevent[ ] significant adverse environmental impact to the fishery habitat." § 503(b)(3)(A). Similarly, section 503(a) requires that the Secretary "maintain the habitats, to the maximum extent feasible, of anadromous and other foodfish." *Accord* 36 C.F.R. § 228.8(e) ("[a]ll operations shall be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources. . . . In addition to compliance with water quality and solid waste disposal standards required by this section, operators shall take all practicable measures to maintain and protect fisheries and wildlife habitat which may be affected by the operations").

Nonetheless, the revised draft demonstrates that in violation of these standards, the marine disposal of tailings will cause substantial and unreasonable degradation to the marine environment. According to the *Revised Draft*, "[m]arine tailings disposal would impact marine ecology by burial of marine organisms and habitats, direct effects of suspended sediments, and possibly by toxicants present in tailings. Burial of several important bottom dwelling species would occur in affected areas." RDEIS at xii. In particular, substantial numbers of economically important bottom fish and shellfish including crabs, shrimp, pollock, rockfish and flatfish will be lost if any of the proposed marine disposal sites are used. "Expected losses of fish from burial and high suspended sediments near the bottom . . . are significant." *Id.* at G-43.[1] Moreover, the EPA *Best Professional Judgment* report notes that "herring and other resident species that feed exclusively on zooplankton are likely to experience detectable increases in heavy metal levels in tissues." RDEIS at S-87.

#1 cont.

Nor is this all. The list of adverse impacts on fishery resources that violate §§ 505(a) and 505(b)(3) goes on and on. The *Best Professional Judgment* report notes that there is a significant likelihood that organisms at higher trophic levels could be contaminated by food: "ingestion of suspended tailings particulates or of contaminated food could potentially lead to metals accumulation in organisms otherwise unexposed to tailings solids or increased levels of dissolved metals. . . . The most likely pathway of contamination of these harvested species is by ingesting contaminated zooplankton that migrate between relatively clean nearsurface and deep waters where suspended tailings fines may be encountered."[2] RDEIS at S-86

[1] The estimated average loss of bottom fish and shellfish by active habitat burial from scheduled tailings disposal is 14,560 kg/yr if the discharge is to the inner basin of Boca de Quadra, 14,070 kg/yr if the discharge is to Smeaton Bay, and 3,190 kg/yr if the discharge is to the middle basin of Boca de Quadra. RDEIS, Table 4-13 at 4-122.

[2] The report cites a study finding "internal accumulations of tailings solids in the guts of euphausiids . . . [which] are known to be utilized directly by pollock, poachers, eelpouts, and pandalid shrimp in the deep benthic food web of both fjords. Euphausiids are also consumed by pollock, herring, dogfish, other demersal fishes, and pasiphaeid shrimps in the mesopelagic food web . . . and by eulachon

and S-88. As the report explains, "[s]ignificant numbers of vertically migrating zooplankton organisms are . . . likely to encounter suspended tailings particles and could accumulate and transport them to near-surface water where predators feed. Once in the acidic environment of the vertebrate gut, metals could be leached out and absorbed into body tissues." *Id.* at S-87. Moreover, the report predicts that [s]ince many zooplanktonic organisms undergo diel vertical migrations, *a major proportion* of the food of higher trophic level organisms (that may otherwise not be in direct contact with tailings) could be contaminated." *Id.* at S-79 (emphasis added).

#1 Cont.

Indeed, the impacts could be even worse, for the *Revised Draft* also recognizes that the assumptions on which its conclusions are based may be invalid and that marine disposal of tailings could cause drastic adverse environmental impacts if tailings discharge does not behave as predicted:

> If the discharge does not behave as predicted and a plume of fines impacts the nearsurface waters, more types of organisms potentially utilized by humans would be affected, including both fish and intertidal invertebrates. Impacts on human health are more likely in this case. . . . Due to the magnitude of material to be discharged, direct effects to the upper water column could be significant if the discharge does not behave as predicted. . . . If tailing fines were unexpectedly distributed into the nearsurface . . . waters, a variety of impacts are possible. These include decreased primary productivity, which would impact the productivity of the epipelagic and mesopelagic food webs; turbidity or suspended solids affects on other organisms (e.g., herring, marine mammals, and migrating salmonids may avoid this area); direct affects (smothering and chronic toxicity) on intertidal and subtidal organisms; bioaccumulation of heavy metals or process reagents (which could lead to effects on marine mammals and shorebirds). . . . The food chain leading to juvenile salmonids may potentially be affected if tailings deposition occurs in the photic zone.

Id. at S-88, S-89 and S-98.

In short, submarine disposal has the kind of impacts that are inconsistent with the protection of fishery values required by ANILCA. While the Act requires preservation of these values, the revised draft proposes to sacrifice an entire fjord to the Borax mine.

#2

B. *Submarine Disposal Violates the Procedural Provisions of ANILCA and NEPA*

In addition, the revised draft violates ANILCA and NEPA because its treatment of potential environmental impacts caused by the proposed disposal of mill tailings in either Boca de Quadra or Wilson Arm/Smeaton Bay is not complete. Specifically,

and herring in the epipelagic food web. . . . Other organisms at higher trophic levels (e.g., baleen whales) may also ingest large numbers of euphausiids." RDEIS at S-87.

the *Revised Draft* violates section 505(b)(1) of ANILCA, which requires that the plan of operations for mining in the Quartz Hill area be "based upon and shall include studies or information which . . . are adequate for evaluating the water quality and water quantity, fishery habitat, and other fishery values of the affected area . . . [and] evaluating to the maximum extent feasible . . . the sensitivity to environmental degradation . . . of the fishery habitat." It violates section 505(b)(2), which requires "that such plan adequately identif[y] the risks the operations under such plan . . . might pose to . . . the natural stability and the present and continued productivity of anadromous fish and other foodfish . . . fishery habitat . . . and other fishery values." And it violates § 102 of NEPA, which requires a "detailed statement . . . on the environmental impact of the proposed action." 42 U.S.C.S. 4332(2)(C)(i).

#2 cont.

The individual violations of ANILCA and NEPA are legion. For instance, although ANILCA and NEPA require complete disclosure, there are numerous examples in the EPA report demonstrating the significant lack of information on the environmental impact of marine tailings disposal and the critical need for further study in, among others, the following areas:

> Increased turbidity in the upper mesopelagic zone could reduce the rearing area for juvenile herring in Boca de Quadra. The significance of this potential impact cannot be determined at this time. . . . Time necessary for complete recovery [of deep benthic organisms] cannot be determined based on existing data. . . . Available information on the toxicity of organic milling reagents is insufficient for determining the hazard associated with their discharge[,] . . . [and t]hus, more information is needed on the fate and effects of the milling reagents (and their breakdown products) proposed for use at Quartz Hill. . . . The considerations described above suggest that the reported toxic concentrations for Quartz Hill mill tailings likely underestimate the actual concentrations at which acute effects may occur. . . . Interpretation of the results [involving testing clam burrowing behavior in tailings] is debatable. . . . Bioaccumulation of water soluble hydrocarbons may occur particularly with tailings discharge to Smeaton Bay[,] . . . [but wh]ether bioaccumulation of hydrocarbons will occur at levels that cause harm to organisms or adversely affect fish harvest quality is not clear because the loading to Smeaton Bay is not clearly understood.

RDEIS at S-79, S-80, S-81, S-83, S-84 and S-87.

Moreover, the potential toxicity of mill tailings is inadequately addressed. The toxicity discussion in the *Revised Draft* is insufficient to evaluate the affects of marine tailings disposal on the biota. *See* RDEIS at G-38-50. For example, the *Best Professional Judgment* report states that "[g]reatest toxicological concern lies with the possibility of effects from long-term, low-concentration exposures in the upper mesopelagic zone[;] . . . [this] cannot not be dismissed as a potential impact, particularly when valid chronic toxicity tests remain to be conducted." *Id.* at S-85.

The *Best Professional Judgment* report also identifies a host of other substantial unanswered questions--each of which must be answered before the impact statement complies with ANILCA and NEPA. "Of greatest concern is the potential reduction in the herring population and subsequent effects on seals and

#2 cont.

piscovorous birds such as mergansers and cormorants[;] . . . it is not possible to determine whether herring abundance will significantly change in Boca de Quadra and Smeaton Bay." *Id.* at S-96. The report further notes that "[i]t is not known whether concentrations of chlorine or dissolved hydrocarbons will meet state standards because concentrations in the effluent are not known." *Id.* at S-114. While the report's projections "indicate that most dissolved metal will probably not be present at concentrations of concern in the receiving water," it states that "[t]hese projections, however, have some limitations in that they may not accurately account for dissolved metals originating from constant loading from continuous discharge, resuspended tailings, or leached tailings. Cumulative levels of dissolved copper or other metals from all possible sources may represent a hazard for aquatic resources." *Id.* at S-115. In addition, "[c]oncentrations of milling chemicals in the effluent are not well characterized and may be more variable than dissolved metals. . . . In summary, actual amounts of organic discharged are not known[,] . . . [and] although concentrations of these reagents [i.e., surfactants] is expected to be low in the discharge . . . data are inadequate to predict concentrations in the effluent and, therefore, effluent behavior on this point." *Id.* at S-117 and S-120.

Furthermore, there are significant unanswered questions specifically involving discharge to the inner basin of Boca de Quadra and to Wilson Arm. "The species composition of the inner basin [of Boca de Quadra] would be altered with the elimination of the mid-depth infaunal assemblage. The importance of this specific habitat and its characteristic assemblage as a spatial and food resource for fish and marine mammals is not known." *Id.* at S-94. In Wilson Arm, "changes in seasonal patterns of nutrient cycling associated with the loss of the fjord-like system could have unknown effects on community structure. . . . During the discharge period, some suspended solids would spill into Behm Canal. . . . The impact of the exported solids on benthic productivity or community structure outside of Smeaton Bay would depend upon the nature of the benthic communities, which presently is an unknown." *Id.*

Thus, although the *Revised Draft* "predicts" that fisheries will not be affected significantly by submarine tailings disposal, the *Revised Draft* itself demonstrates that this prediction is insufficiently supported. Rather, the *Revised Draft* shows that throughout the analysis key issues are neglected. Therefore, under NEPA and ANILCA, further studies of the environmental impact of marine tailings disposal must be conducted.[3]

#3

[3] Also, NEPA requires that the Forest Service further evaluate the potential impacts of on-land tailings disposal alternatives and the availability of measures to mitigate such impacts. The environmental concerns presented by these alternatives were not adequately discussed in the revised draft.

C. *The Middle Basin of Boca de Quadra is the Most Preferable Basin for Submarine Disposal*

#4

As stated in our comments to the project's first draft environmental impact statement, if a submarine disposal site must be chosen, it should be one in the middle basin of Boca de Quadra. Disposal into this basin is most consistent with the provisions of subsections 505(a) and 505(b)(3) of ANILCA. *Accord* 36 C.F.R. 228.8(e).

Although the Forest Service recommends disposal into Wilson Arm/Smeaton Bay, disposal there would be inconsistent with ANILCA's substantive provisions for fishery protection. Wilson Arm and Smeaton Bay are part of the most important fishery in Southeast Alaska. The revised draft states that the Wilson River is a major salmon habitat (e.g., the river "is extensively utilized for spawning"). RDEIS at 4-107. "Pink salmon are the most abundant species in the project area. The Wilson River has the largest population of pink salmon.... Collectively the Wilson-Blossom system accounts for more than 80 percent of the average pink salmon escapement to the three major rivers." *Id.* at 3-62. Salmon spawned in the Wilson River provide the largest proportion (5 percent) of the regional catch compared to the contributions from the Keta (2 percent) and Blossom (2 percent) rivers. *Id.* at 3-64. "The Wilson and Blossom rivers support a combined salmon run (all species-average return) of about 1.6 million fish," and an estimated annual average harvest over the past several years of 1.1 million fish. *Id.* at xvi and xvii. Thus, the Wilson and Blossom Rivers support extremely valuable fisheries which cannot legally be threatened. Yet the disposal of mill tailings into Wilson Arm/Smeaton Bay would do precisely that. Among other reasons, the fisheries would be threatened because of the possibility that tailings discharge will not behave as predicted (e.g., near-surface waters could be impacted by discharged particulates) and that the toxicity of the tailings is greater or more harmful than predicted.

The reasons the Forest Service prefers the disposal of tailings in Wilson Arm are unfounded. In the first place, the Forest Service's alternative is based on several assumptions which are tenuous and unsupported. For example, the Forest Service claims that with appropriate mitigation the impact of disposal on anadromous fish, other food fish, and fish habitat is similar in both fjords. RDEIS at xv. However, this assumes a number of critical variables which the *Revised Draft* does not substantiate or support: e.g., that appropriate mitigation measures are adequately comprehended; that such measures are technically feasible; that such measures will be taken not only over the life of the operation, but also until the mine tailings no longer possess the potential to adversely impact the marine biota; that accidents or unforeseen complications, such as a break in a tailings pipeline, will not occur; that the Wilson Arm/Smeaton Bay fjord will be large enough to accommodate all the tailings; that all significant environmental impacts of tailings disposal on the marine biota are known and analyzed in the revised draft including such factors as the potential of leaching of metals from the tailings, the uptake of these metals by the biota, and the transformation of a deep fjord system to a bay-like system; and that the tailings will actually behave as "predicted" (e.g., resuspension of tailings will not occur). Moreover, if these assumptions are false, the destruction to fish and fish habitat probably will be substantially greater than if

#4 Cont.

the assumptions underlying the conclusion that marine tailings disposal will not adversely impact Boca de Quadra are false because the salmon resources at risk in Wilson Arm and Smeaton Bay are significantly larger than those in Boca de Quadra. Specifically, the Wilson and Blossom Rivers support a combined salmon run of about 1.6 million fish, while the three principal rivers draining into Boca de Quadra support a combined run of only about 500,000 fish. *Id.* at xvi-xvii.

#5

The Forest Service is also wrong in supporting the Wilson Arm alternative because the impacts of the mine would be confined to a single drainage if tailings are disposed in Wilson Arm. EPA's *Best Professional Judgment* report recognizes that "[a]ny increases over predicted volumes or an error in the predictions in the sedimentation model could result in the overfilling of Smeaton Bay." *Id.* at S-31. "In the latter years of the project mine life, containment in this basin [i.e., Wilson Arm/Smeaton Bay] is not assured as it would be in Boca de Quadra. Therefore, there is a greater potential for effect on the estuarine habitat in this basin due to resuspension of tailings." *Id.* at xvi. If this occurs, then the potential for significant impacts on the fish and fish habitat in Wilson Arm is great; alternatively, it may be necessary to discharge tailings into Boca de Quadra. Since Wilson Arm is a substantially more productive fishery than Boca de Quadra, it is more reasonable and more consistent with ANILCA's requirements to discharge tailings into the middle basin of Boca de Quadra in order to minimize the project's potential impacts to the Wilson Arm fishery.

#6

Nor are the Forest Service's remaining arguments any more persuasive. The Forest Service claims that discharge to Wilson Arm "reduces the impacts on wilderness values since it is not necessary to construct facilities for tailings disposal in the Misty Fjords National Monument as would be required if disposal were in the Boca de Quadra." *Id.* at xv. However, the *Revised Draft* itself states that although the "physical extent of reductions in apparent naturalness within the wilderness would be increased compared to all other options . . . the net change would not be sufficient to alter impact ratings . . . Tailings disposal in the middle basin of Boca de Quadra . . . would not cause an identifiable change in effects on ecological values." *Id.* at 4-254. In addition, the Forest Service position on wilderness values fails to acknowledge that the potential impact on marine biota is substantially less if tailings are disposed in the middle basin of Boca de Quadra. Under the more reasonable EPA prediction that substantially less environmental impact would result from disposal in Boca de Quadra (impacting a small and localized segment of the wilderness area) than in Wilson Arm, the middle basin alternative is more in accordance with wilderness values (particularly since the entire mine project is in the center of Misty Fjords National Monument Wilderness). Also, the Forest Service position lacks merit due to the possibility that an intertie to Quartz Hill will be constructed overland through substantial portions of wilderness and nonwilderness areas within the Misty Fjords National Monument rather than underwater through Wilson Arm, because mine tailings in Wilson Arm will preclude this alternative. Thus, significantly greater adverse wilderness and nonwilderness impacts will result from disposal in Wilson Arm.

#7

Similarly, the Forest Service position that disposal in Wilson Arm "would result in greater community stability for Ketchikan and Southeast Alaska because of

#7 cont.

reduced operating costs and lesser development costs compared to disposal in Boca de Quadra" is entirely speculative. *Id.* at xv. There is no support for the position that the relatively insignificant reduction in capital and operating costs that might result if Borax is permitted to dispose mill tailings in Wilson Arm will benefit the people of Southeast Alaska, the historic molybdenum markets notwithstanding. In fact, if Wilson Arm is adversely affected by the disposal of mill tailings then the mitigation/reclamation costs alone could far surpass the savings resulting from disposal to Wilson Arm rather than the EPA preferred alternative (i.e., the middle basin of Boca de Quadra). Moreover, this reasoning supports the position that potential severe environmental impacts can be disregarded if the company might thereby benefit. This is contrary to the express intention of ANILCA. The Forest Service also fails to weigh the potential cost to Southeast Alaska of the destruction of the fisheries dependent on Wilson Arm against the possibility that lower costs to Borax will result in increased stability for the area.

#8

At bottom, the problem with submarine disposal anywhere but the middle basin of Boca de Quadra is that the other disposal areas threaten far greater environmental damage. With regard to Wilson Arm, for example, the *Best Professional Judgment* report states that "[p]otential harvests of demersal fish and shellfish will likely be reduced with a discharge to Wilson Arm because tailings are expected to accumulate on the bottom and be suspended in the water column above the 100 m isobath. Relatively shallow deposits of tailings can alter benthic habitat and effect the food sources for commercial species." *Id.* at S-108. The *Best Professional Judgment* report also states that "[d]ischarge to Smeaton Bay would have effects on potential and existing harvests of shrimp and Dungeness crab similar to those for discharge to the inner basin of Boca de Quadra." *Id.* at S-98.

Similarly, disposal to the inner basin of Boca de Quadra would also be inconsistent with ANILCA's substantive provision for fishery protection. Since the tailings could not be contained in the inner basin, disposal in this basin would substantially impact on both the inner and middle basins of Boca de Quadra. "For a discharge into the inner basin . . . the inner basin would be filled to the depth of the sill separating it from the middle basin after a period of 10-14 years. For the remaining 41-45 yrs of operation, the discharged material would settle into the middle basin of Boca de Quadra." *Id.* at S-26. Disposal of tailings in the inner basin "could significantly affect potential harvests of shrimp in the inner and middle basins as well as potential and existing harvests of Dungeness crab in the inner basin. Turbidity in the lower depth range of herring habitat could cause displacement of the large population of herring that inhabit the fjord year-round." In addition, if discharge is to the middle basin "[r]elatively little impact is expected to demersal fish and shellfish species in the inner basin during or after the project. This is in contrast to the adverse effects to both basins when discharging to the inner basin." *Id.* at S-107.

In contrast, the impacts to the middle basin of Boca de Quadra are fewer. Although discharge to the middle basin of Boca de Quadra is not without adverse impacts in violation of ANILCA (e.g., "[d]ischarge to the middle basin would adversely affect deepwater demersal species such as halibut, Tanner crab, and shrimp during the period of discharge to that basin"), disposal there will result in

the least adverse impact. *Id.* at S-107. The *Best Professional Judgment* report states that "[o]verall, the Boca de Quadra middle basin discharge option is expected to have less biological impact." *Id.* at S-80; *See Id.* at xv-xvi, S-80-81 and S-98. Because of the shallower water depths in Smeaton Bay and the inner basin of Boca de Quadra, contamination of a major proportion of the food of higher trophic organisms is more likely to occur in these areas than in the middle basin of Boca de Quadra. *Id.* at S-79. Discharge to the middle basin of Boca de Quadra "would likely affect harvests less than discharge to the inner basin." *Id.* at S-107. A middle basin disposal would decrease below-sill capacity of the middle basin by only 20 percent, and "would have no effect in the outer basin or oceanic areas at the mouth of Boca de Quadra due to the isolating influence of the Kite Island and outer sills." *Id.* at S-31 and S-94. Also, "[d]ischarge to the middle basin appears to threaten marine birds and mammals less than discharge to the inner basin or Smeaton Bay for several reasons." *Id.* at S-96.

Therefore, the requirements of subsections 505(a) and 505(b)(3) of ANILCA--i.e., that productivity be maintained, that significant adverse impact be avoided, and that fishery protection be achieved to the maximum extent feasible--require that Wilson Arm/Smeaton Bay and the inner basin of Boca de Quadra be undisturbed. Preservation of Wilson Arm/Smeaton Bay and the inner basin of Boca de Quadra is especially required when, as here, there are reasonable alternative disposal locations. Since fishery resources will be least at risk if disposal occurs in the middle basin of Boca de Quadra, if submarine disposal occurs, ANILCA's substantive provisions for fishery protection make the middle basin the legally required choice.[4]

II. *THE PROPOSED WATER SUPPLY SOURCE VIOLATES ANILCA AND NEPA*

#10

The *Revised Draft* demonstrates that the Wilson River well field is not a reasonable supplemental water supply. As noted above, the Wilson River is a major fishery in Southeast Alaska. For example, it is the largest pink salmon producing river in Alaska. However, according to the *Revised Draft*, despite the Wilson River's great importance as a fishery, proposed water withdrawals from it "during low flow periods would result in significant impacts to Wilson River flows . . . [and] if very low flows occur during the incubation period, the impacts could be significant on a short but very productive reach of salmon habitat." RDEIS at 2-32 and 2-33. Moreover, there appears to be no practical mitigation. Maintaining an

#9

[4] If the middle basin of Boca de Quadra is to be used, NEPA and ANILCA require that the Forest Service study the middle basin of Boca de Quadra to determine the preferred alternative site for the tailings pipeline. 40 C.F.R. § 1502.9(1)(ii). An adequate analysis would model the effects of tailings disposal at different sites in the middle basin and compare the advantages and disadvantages of the alternative outfall sites. The additional analysis would generate "significant new . . . information"; it would therefore require circulation of a supplement to the *Revised Draft*. Id. The expanded discussion on disposal into the middle basin must include a section on what special considerations must precede routing tailings through a wilderness area.

instream flow requirement of 225 cfs would protect the river to some extent, but it would also cause mining operations to be discontinued for up to seven weeks during dry or cold years. *Id.* at 4-108.

#10 cont.

Thus, adopting the Wilson River well field as a supplemental water supply would violate ANILCA, which establishes strict requirements for the protection of fisheries. *See* § 505; *Accord* 36 C.F.R. § 228.8(e) (the Wilson River water supply alternative also violates U.S. mining regulations protecting fisheries). In short, because the Wilson River fishery will be affected significantly, subsections 505(a) and 505(b)(3) of ANILCA require the adoption of an alternative supplemental water source, which U.S. Borax has recently stated is possible. *See* Meeting in Governor's Conference Room (April 29, 1987) (identifying a confluence pool on the Blossom River as a practical alternative).[6]

III. *THE REVISED DRAFT IS INADEQUATE BECAUSE IT FAILS TO ADEQUATELY DISCUSS WHAT MITIGATION MEASURES WILL BE TAKEN TO PROTECT THE ENVIRONMENT AND AFFECTED FISHERIES AND WILDLIFE HABITAT*

ANILCA, NEPA and U.S. mining laws require the thorough consideration of mitigation efforts that will maintain and protect the environment and fisheries and wildlife habitat. Thus, section 505(a) of ANILCA requires that the "[t]he Secretary . . . maintain the habitats, to the maximum extent feasible, of anadromous fish and other foodfish, and to maintain the present and continued productivity of such habitat when such habitats are affected by mining activities on national forest lands in Alaska." Similarly, under subsections 505(b)(3)(A) and (B) of ANILCA, the Secretary must determine that the required plan of operations "includes provisions which . . . are adequate for the purposes of (A) preventing significant adverse environmental impacts to the fishery habitat . . . or other fishery values; and (B) maintaining present and continued productivity of the habitat of anadromous fish and other foodfish which might be affected by the mining and other activities proposed." *Accord* 42 U.S.C.S. § 4332(C)(ii), (iv) (every environmental impact statement must include a detailed discussion of "any adverse environmental effects which cannot be avoided should the proposal be implemented, . . . [and] the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity"); 36 C.F.R. § 228.8(e) (the mine operator "shall take all practicable measures to maintain and protect fisheries and wildlife habitat that may be affected by the operations"). Therefore, the

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[6] However, the Blossom River alternative could not be selected legally without additional studies of the impact of the construction of a weir on Blossom River, since this river is a very substantial salmon producer. For example, the *Revised Draft* indicates that a concrete weir at the mouth of the Blossom River could adversely impact chinook salmon smelts. RDEIS at 4-104. Although the *Revised Draft* claims that potential impacts of this blockage to chinook salmon is unlikely because the smelts would have access to the lower Wilson River, it is not clear whether this conclusion considers the effect of the increase in competition for the remaining available resources.

#11

Secretary cannot determine the adequacy of the plan of operations without considering what mitigation efforts will be taken to minimize the adverse environmental impacts of the mine.

#12

Nonetheless, the *Revised Draft* is inadequate under these standards because its discussion of the required mitigation efforts is incomplete. The *Revised Draft* states that "mitigation of impacts to fisheries would be necessary because the impacts of each of the project development alternatives would be substantial," but there are several substantial deficiencies in the material on mitigation measures. For example, the *Revised Draft* fails to discuss what measures will be taken to mitigate the adverse impacts of potential earthquakes, landslides and avalanches in sensitive areas during the fifty-five years of operation and the reclamation period. Since an earthquake, landslide or avalanche in a sensitive area could cause enormous adverse environmental impacts and the occurrence of such events is reasonably foreseeable, the *Revised Draft* should contain a detailed discussion describing appropriate mitigation measures. Moreover, since this will present "significant new . . . information relevant to environmental concerns bearing on the proposed action or its impacts," the discussion comparing the different mitigation alternatives should be circulated initially as a supplement to the public *Revised Draft* for public review and comment. 42 U.S.C.S. § 4332(2)(C)(iii).

#13

There are several other examples of the inadequacy of the discussion on mitigation measures. The *Revised Draft* states that gravel cleaning would be an important mitigation measure (e.g., to remove sedimentation from spawning gravel caused by road use). RDEIS at 4-283 and Table 4-43. However, the effectiveness of this measure appears greatly overestimated. In fact, the aquatic habitat may experience greater negative than positive impacts if this mitigation method is used. *Id.* at 4-283. Another example of the inadequate discussion of mitigation is the lack of measures to mitigate potential adverse impacts of the tailings pipes. The *Revised Draft* states that tailings pipe wear rapidly from the abrasive sediment and corrosive chemicals they carry and may last only from four months to three years, but there is no discussion regarding the environmental impacts of pipe "wear" (e.g., the discharge of polypropylene into the marine environment) or measures to mitigate such impacts (e.g., use of alternative materials for tailings pipes).[6]

#14

#13/14

[6] In the event that gravel cleaning is not feasible or actually would damage the environment or that the wear of the tailings pipes would have a significant adverse impact, then compliance with NEPA requires that there be "a detailed statement . . . on . . . alternatives to the proposed action." 42 U.S.C.S. § 4332(2)(C)(iii). This statement should discuss such alternatives as other methods of mitigating the impacts of sedimentation and tailings pipes made from other materials. Since this will present "significant new . . . information relevant to environmental concerns and bearing on the proposed action or its impacts," the discussion comparing the different alternatives should be circulated initially as a supplement to the public for review and comment. 40 C.F.R. § 1502.9(c)(1)(i).

Finally, the discussion on mitigation measures fails to identify which party will be responsible for the costs of both mitigation and monitoring.

#15

IV. *THE OCEAN DISCHARGE CRITERIA ARE INVALIDLY DETERMINED NOT TO APPLY*

In contravention of the EPA *Ocean Discharge Criteria Evaluation: Quartz Hill Mine Tailings Disposal in Boca De Quadra* study, the *Revised Draft* provides that the ocean discharge criteria do not apply to the Quartz Hill project. RDEIS at Errata. This is invalid.

According to the EPA *Ocean Discharge Criteria Evaluation* (ODCE) for the proposed discharge of mine tailings to Boca de Quadra,

> [t]he U.S. Environmental Protection Agency *must* determine whether unreasonable degradation of the marine environment will result from a proposed effluent discharge before issuing a permit. The evaluation *must* follow guidelines (Ocean Discharge Criteria) established by the agency. If the discharge is expected to unreasonably degrade the marine environment, the permit may not be issued. If insufficient information is available to make a determination, the permit may not be issued unless the available data indicate that no irreparable harm will occur during the time monitoring is conducted.

ODCE at i (emphasis added). Nonetheless, in the *Revised Draft*, the Forest Service states that the ocean discharge criteria do not apply. This decision was based solely on an off-the-record communication indicating that "the U.S. Department of State . . . recently established closure lines at the entrance to Smeaton Bay and Boca de Quadra (Colson, personal communication March 25 and April 28, 1986)." RDEIS at S-1.

#16

In so ruling the ocean discharge criteria inapplicable, the Forest Service violated section 403 of the Clean Water Act. 33 U.S.C. § 1343. This section requires compliance with guidelines intended to determine the degradation of waters of the territorial seas, the contiguous zone and the ocean. Under section 403 of the Clean Water Act, a section 402 NPDES permit for discharge into the territorial sea, the waters of the contiguous zone or the oceans may be issued only after promulgation of ocean discharge criteria for such discharge under section 403(c). 33 U.S.C. § 1343(a). Also, under the U.S. mining laws, the requirements of the Clean Water Act apply to the Quartz Hill project: "[a]ll operations shall be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources, including the . . . water quality. Operator shall comply with applicable Federal and State water quality standards, including regulations issued pursuant to the Federal Water Pollution Control Act." 36 C.F.R. § 228.8(b).

Although the EPA will "use the Ocean Discharge Criteria (40 C.F.R. Part 125, Subpart M) as a means to complete an environmental evaluation of estuarine and marine impacts using Best Professional Judgment," the question as to whether section 403 of the Clean Water Act applies is significant as a matter of law. RDEIS

#16 cont.

at S-1. Under the invalid *Revised Draft* determination, therefore, while EPA will use the ocean discharge criteria evaluation in determining whether to grant a NPDES permit, EPA is not required to deny a permit if the ocean discharge criteria guidelines and other § 403 provisions of the Clean Water Act are not met. However, if the ocean discharge criteria apply as a matter of law and the § 403 guidelines and provisions are not met, EPA would be required to deny a NPDES permit: "No permit under section 402 of this Act [33 U.S.C.S. § 1342] for a discharge into the territorial sea, the waters of contiguous zone, or the oceans shall be issued, after promulgation of guidelines established under subsection (c) of this section, except in compliance with such guidelines." 33 U.S.C.S. § 1343(a). In addition, "[i]n any event where insufficient information exists on any proposed discharge to makė a reasonable judgment on any of the guidelines established pursuant to this subsection no permit shall be issued under section 402 of this Act." 33 U.S.C.S. § 1343(c)(2).

Even assuming that the ocean discharge criteria do not apply to tailings disposal in Boca de Quadra and Smeaton Bay because these are inland waters, an ocean discharge criteria evaluation is required if tailings are disposed of Wilson Arm because this would effectively constitute a discharge into Behm Canal which is part of "the territorial sea, the waters of the contiguous zone, or the oceans." 33 U.S.C.S. § 1343(a). As EPA states:

> The fjord model predicts outward transport of suspended fines across the outer sill into Behm Canal at concentrations 2-20 mg/l. . . . Because the outer sill [of Smeaton Bay] is below the level of the pycnocline, suspended fine tailings would advect into Behm Canal. . . . All of Smeaton Bay and part of Behm Canal will need to be designated as a mixing zone if tailings discharge is made to Wilson Arm.[7]

RDEIS at S-25, S-90 and S-114 (emphasis added). Thus, the *Revised Draft* demonstrates that discharge into Wilson Arm constitutes discharge into Behm Canal. An ocean discharge criteria evaluation is required for such discharge.

---

[7] The fact that tailings disposal into Wilson Arm involves discharge into Behm Canal and that the effect of such disposal on Behm Canal is unknown is repeated throughout the *EPA's Best Professional Judgment* report. "[T]ransport of fines out of Smeaton Bay into Behm Canal is projected to occur. . . . As no information is available on the hydrography/circulation of Behm Canal, it is not possible to determine the ultimate fate of the existing fines." RDEIS at S-63. "Smeaton Bay . . . communicates more freely with the Alaskan costal waters." Id. at S-64. "During the discharge period, some suspended solids would spill into Behm Canal. . . . The impact of the exported solids on benthic productivity or community structure outside of Smeaton Bay would depend upon the nature of the benthic communities, which presently is unknown." Id. at S-94. "Discharge to Smeaton Bay would have significant and permanent effects on benthic productivity and composition of benthic communities because it would become a relatively shallow embayment with no remaining deep water infaunal habitat and essentially no physical separation from Behm Canal." Id. at S-97.

V. *THE QUARTZ HILL PROJECT IS DIVIDED INTO TWO STATIONARY SOURCES FOR PSD APPLICABILITY IN VIOLATION OF THE CLEAN AIR ACT*

#17

The U.S. mining laws require that all mine operators comply with the PSD provisions of the Clean Air Act, and thus with 18 A.A.C. 50.020. 36 C.F.R. § 228.8(a). The *Revised Draft* does not show that this will occur, however. Therefore, on the present record, no mining permit can be issued.

The specific problem is that the *Revised Draft* states that "the Quartz Hill Project is considered to be two distinct and separate air quality sources," RDEIS at x, but provides no justification for this conclusion. The Environmental Protection Agency regulations define "building, structure, facility or installation" as "all of the pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control)." 40 C.F.R. 52.21(b)(6). The air quality control regulations of the Alaska Department of Environmental Conservation apply essentially the same definition of "facility," 18 A.A.C. 50.900(21) ("pollutant-emitting sources or activities which are located on one or more contiguous or adjacent properties and which are owned or operated by the same person or by persons under common control"). Thus, before determining that the mine site and power plant/marine terminal site are separate stationary sources, the Alaska Department of Environmental Conservation must demonstrate that emissions from sources at each site will not combine (i.e., that the sites are in distinct airsheds) in order to establish that the sources at each site are not on contiguous or adjacent properties. This includes demonstrating that such variables as air currents separate the sites.

The deficiency in the air quality analysis is also a NEPA violation. NEPA requires the completion of a detailed discussion of the environmental impact of the Quartz Hill project including its impact on air quality. Therefore, the Forest Service must demonstrate that the sites are in distinct airsheds because the issuance of two air permits will have a different environmental impact than the issuance of one air permit. 42 U.S.C.S. § 4332. As part of EPA's comprehensive study of the environmental impact of the project's air pollution, the EPA must then circulate the studies of the airshed at each site as supplements to the *Revised Draft* for public review and comment because this additional analysis will generate "significant new . . . information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c)(1)(i).

VI. *THE REVISED DRAFT IS INADEQUATE BECAUSE IT FAILS TO SET AN APPROPRIATE BOND*

#18

Under U.S. mining laws, miners operating on national forest land, when required by the Forest Service, must provide a bond conditioned upon completion of reclamation activities required under 36 C.F.R. § 228.8(g). 36 C.F.R. § 228.13(a). The amount of the bond is based on the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations. 36 C.F.R. § 228.13(b).

#18 cont.

The *Revised Draft* states that the Forest Service will review the existing reclamation bond and require U.S. Borax to provide additional bonding if necessary. RDEIS at 2-7. It does not discuss how much bond will be required, however, and so is unlawful. A complete Environmental Impact Statement must include a detailed discussion of the amount of the bond, since the bond will have a substantial environmental impact if U.S. Borax fails to complete the required reclamation activities. Furthermore, as part of the Forest Service's comprehensive study of the environmental impact of the project, the Forest Service must then circulate the study on the amount of the bond as a supplement to the *Revised Draft* for public review and comment because this additional analysis will generate "significant new . . . information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. §1502.9(c)(1)(i).

VII. *THE REVISED DRAFT VIOLATES ANILCA AND NEPA BECAUSE IT FAILS TO DISCUSS THE ENVIRONMENTAL IMPACTS OF AN INTERTIE AND A LOG TRANSFER FACILITY*

#19a

#19b

We have recently learned that there is a substantial possibility that a power intertie and a log transfer facility will be constructed. Therefore, since these projects are reasonably foreseeable, their environmental impacts must be discussed in the environmental impact statement. *See, e.g.*, 36 C.F.R. § 228.4(d) ("The plan of operations shall cover the requirements set forth . . . as foreseen for the entire operation for the full estimated period of activity"); 40 C.F.R. § 1508.25. Moreover, in both cases, the new projects represent significant changes. For example, the construction of an intertie represents a substantial environmental impact--particularly if tailings disposal is to Wilson Arm, thereby causing the intertie to be constructed overland through a substantial portion of wilderness and nonwilderness areas. Therefore, the additional analysis will generate "significant . . . new . . . information" and require a supplement to the *Revised Draft* and an opportunity for public review and comment on such supplement. 40 C.F.R. § 1502.9(c)(1)(i).

#20

In addition to the comments submitted here, we incorporate by reference our previous comments on the first draft environmental impact statement for the project, *see* Letter from Philip S. Barnett, Sierra Club Legal Defense Fund, to Win Green, Department of Agriculture (Oct. 30, 1984) (commenting on the project's first draft environmental impact statement), and our previous comments to the Environmental Protection Agency on its draft NPDES permit. *See* Letter from Philip S. Barnett, Sierra Club Legal Defense Fund, to Robert Burd, Environmental Protection Agency (Oct. 3, 1984) (commenting on the project's draft NPDES permit).

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We hope that these comments will provide assistance to you. We look forward to your response on the points we have raised.

Sincerely,

Philip S. Barnett
Staff Attorney

Alan Birnbaum
Law Clerk

cc: Robie G. Russell, Regional Administrator, Environmental Protection Agency, Region 10
Dennis Kelso, Commissioner, Alaska Department of Environmental Conservation
Jack Hession, Alaska Representative, Sierra Club
Bart Koehler, Executive Director, Southeast Alaska Conservation Council
Susan Alexander, Regional Director, The Wilderness Society, Alaska Region
John Peckham, President, Southeast Alaska Seiners

253

KETCHIKAN AIR SERVICE, INC
KETCHIKAN INTERNATIONAL AIRPORT NO 1600
KETCHIKAN, AK 99901
907 225 6608

Cessna

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FOREST SUPERVISORS OFFICE

June 30, 1987

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AIR CARGO PICK UP & DELIVERY
FISHING LICENSES

Mr. Win Green, Forest Supervisor
U.S. FOREST SERVICE
United States Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

As a resource supplier, Alaska's economy struggles with a "boom or bust" history. As the owner of Ketchikan Air Service, and a supplier of products and services, I too struggle to maintain a balanced economy. Through Ketchikan Air Service (with subsidiaries Ketchikan Travel Service and Southeast Answering Service) I employ 20 staff here in Ketchikan, and through Juneau Airport Services I employ 6 staff.

Consequently I am writing in support of U.S. Borax's proposed EIS of the Wilson Arm Tailings Disposal. The manner in which Borax will be allowed to develop the Quartz Hill project will have a profound effect on its cost structure and potential profitability, and certainly on the stabilization of the economy of Ketchikan.

A major advantage of utilizing Wilson Arm for tailings disposal is the confinement of mine development to a single drainage. This avoids spreading the impacts to a second drainage basin, which I understand will be 18 square miles, most of which is in the Misty Fjords National Monument. Since I offer "Flightseeing" tours of that area for about nine months of the year, I want to show clients the pristine wilderness they expect. (Flightseeing is a big portion of our air charter business.) Using the Wilson Arm site also eliminates the need to construct tailings disposal facilities in the wilderness of Boca de Quadra. (It is projected that the Boca de Quadra tunnel portal would occupy about 25 acres stretching from tidewater to an elevation of about 100 feet.

As a Ketchikan resident, I have been impressed with the thorough collection of information and the detailed analysis of the Quartz Hill project, not just in regard to marine and water impacts, but to the overall social and economic impacts on this community. I feel the building of the 10 mile access road illustrates Boraz's professional

Telex #5106018031 24 hours (907) 225 9888

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competance. That road, as described by the Forest Service itself, was completed in an "environmentally sound manner under extremely difficult conditions."

Regarding the water supply aspect - again, looking at the "literal overview," I would prefer the lesser height dam with well water supplement as proposed by Borax during Phase I. Yet I do understand that Chris Hesse, Vice President and Project Manager of Quartz Hill has stated that "to avoid possible environmental disadvantages to the Wilson River wells (we are) willing to use the Blossom River source preferred by the Forest Service."

I appreciate the opportunity to express my views concerning this project; thank you for your attention to my comments.

Sincerely,

Michael B. Salazar
President

MBS/b

cc: Don Finney
Bob Kendall
Chris Hesse

254

Citizens' Advisory Commission on Federal Areas
515 Seventh Avenue
Suite 310
Fairbanks, Alaska 99701
(907) 456-2012

June 30, 1987

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TONGASS NF
KETCHIKAN, AK 99901

Mr. Edward R. Johnson
Interdisciplinary Team Leader
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson,

The Citizens' Advisory Commission on Federal Areas has reviewed the Revised Draft Environmental Impact Statement (RDEIS) for the U.S. Borax Quartz Hill Molybdenum Project Mine Development and submits the following comments for inclusion into the public record.

At its June 12, 1987 meeting the Commission approved a motion to support the U.S. Forest Service preferred alternative. This action reflects previous Commission support for a similar alternative in the 1984 draft EIS. That alternative also proposed to dispose of mine tailings in the Wilson Arm/Smeaton Bay rather than the Boca de Quadra. The Commission believes that, with properly planned and implemented mitigation measures and a conscientious monitoring program, the preferred alternative will not have significantly greater environmental impacts than the originally planned Boca de Quadra disposal site.

At the same time, the Commission is aware of existing concerns about the impacts of the proposed Wilson Arm disposal site and the supplemental water supply well field in the Wilson River on the commercial fisheries resources, particularly salmon, within this river and fjord system. These are valid concerns and from our review of the RDEIS it appears that these concerns have been recognized and addressed in the development proposal. More importantly, the potential impacts to these resources must continue to be monitored as the mine site is developed and begins production.

In addition to the appropriate mitigation and monitoring measures which will be developed for the mine project, ANILCA Section 505(b)(5) provides a mechanism whereby the Secretary of Agriculture can immediately halt any mining activity that is determined to be causing irreparable harm to anadromous fish, other foodfish or their habitat.

The figures in Table 18-2, Appendix G indicate that in a "worst case" scenario, the total value of commercial fish and shellfish which could conceivably be lost for the Boca de Quadra alternative would be $5,005 and for the Wilson Arm alternative the total value

lost would be $7,334. The potential for loss is somewhat greater under the Forest Service preferred alternative, but again, only under a "worst case" scenario.

Certainly, neither level of loss would be desirable, but these figures represent losses that would occur only as the result of some type of catastrophic event or a sequence of events. The likelihood of this occurring is low and the normal operation of the mine, mill site, well field, tailings disposal system and related facilities are not expected to significantly impact the commercial fishery, regardless of the alternative selected.

Another point to consider is the fact that once tailings deposition is completed in the Wilson Arm area the remaining basin will be much shallower. As the RDEIS (pg. 2-38) points out this will cause reduction in some deepwater species within the basin, but populations of other commercially desirable species such as dungeness crab will be enhanced.

Data presented in the RDEIS indicate that the Wilson Arm disposal site has the capacity to hold the tailings from the processing mill and still have sufficient depth to allow the passage of salmon and other anadromous fish to their spawning grounds in the Wilson and Blossom Rivers. There is some question about the possibility of a turbidity plume at the outfall of the tailings pipeline affecting the water quality of the fjord under certain conditions. This concern further emphasizes the need to develop and implement proper mitigation measures and contingency plans to deal with this potential situation should it become a problem for migrating salmon.

Assuming that any negative impacts to the commercial fishery from tailings disposal within the Wilson Arm can be successfully mitigated and there is no significant difference between the impacts of the two disposal alternatives, it then becomes necessary to compare some other aspects of the alternatives and measure additional benefits of the preferred alternative.

As the RDEIS acknowledges, there will undoubtedly be some impacts to the surrounding monument. Necessary measures to minimize these impacts have been planned in all alternatives of the development proposal. One major benefit of the preferred alternative stems from the fact that by locating the tailings disposal in the Wilson Arm, all activities from development and operation of the mine will be confined to a single drainage. This in turn should serve to reduce the overall impacts to the surrounding monument lands and its fish and wildlife resources.

The Commission is also aware that one of the major sources of concern and opposition to the development of this mine project stems from its location within a national monument that is

predominantly a Congressionally designated wilderness area. Confining the development activities to a single drainage will also reduce impacts to those resources or amenities the public has come to expect from designated wilderness areas. The ability of federal agencies to actively manage resources in wilderness areas is limited by both law and regulation. In the unlikely event that significant impacts occur to the resources in the designated wilderness of the monument, it may be more difficult for the Forest Service to correct those impacts. By eliminating the possibility of significant impacts to the wilderness area from the beginning by confining development to a single drainage long term management of the monument will be made easier.

A review of the costs associated with the development of the mine project clearly indicates that initial capital investment as well as operating costs over the life of the mine will be considerably lower for the Wilson Arm alternative than the Boca de Quadra option. Figures presented in the RDEIS show that the cost of constructing a 7 mile tunnel needed to dispose of tailings in the middle basin of Boca de Quadra is approximately $69 million. By comparison, the cost of a tailings pipeline to the Wilson Arm site is approximately $9.4 million. The additional operating costs associated with the Boca de Quadra alternative for tailings disposal is around $1.6 million per year. Over the approximate 55 year mine life the additional operating cost would exceed $80 million dollars.

The RDEIS (pg. 2-49) points out that this increase in capital and operating costs for the Boca de Quadra alternative essentially imposes a 55 cent per pound cost penalty on the selling price of molybdenum above the Wilson Arm disposal alternative. This cost penalty effectively means that the mine operation would be more susceptible to shutdown should the price of molybdenum fluctuate significantly. The Commission believes that a much more economically stable operation can be achieved under the preferred alternative.

As previously stated, it appears that the RDEIS has considered all identified concerns regarding the development of this project. In our review of the RDEIS we found that both known and potential impacts, positive and negative were adequately discussed. We realize that conclusive answers to every question cannot be given at this point. Actual effects of mine development, tailings disposal, water usage, power generation and many other aspects of the project will not be known until they are underway. The Commission urges that all parties involved in the permitting and operation of this project continue to work toward developing appropriate mitigation and monitoring programs to ensure that impacts to other area resources and resource users are minimized.

Mr. Edward R. Johnson
June 30, 1987

Page 4

The Commission believes that the Quartz Hill project will make a valuable contribution to the much needed economic diversification of the State of Alaska. We believe that the project can be successfully developed from both an economic and environmental standpoint. While there will be some impacts, the benefits associated with this project should far outweigh the negative aspects. The Commission looks forward to continuing our participation in any future planning efforts for the Quartz Hill Molybdenum Project.

Sincerely,

Stan Leaphart

Stan Leaphart
Executive Director

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TONGASS NF
KETCHIKAN, AK 99901

James L. Cronin
113 Columbia Avenue
Mill Valley, California 94941

June 29, 1987

Mr. Edward R. Johnson
Interdisciplinary Team Leader
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Subject: Comments to the Quartz Hill Molybdenum Project - Revised Draft Environmental Impact Statement

Dear Ed:

I would like to make some general comments to the revised draft EIS in support of the Forest Service's preferred alternative for tailings disposal in Wilson Arm/ Smeaton Bay. There has been extensive baseline studies and evaluation of potential impacts due to the discharge of mine tailings to the two fjord systems including review of current operations at the Island Copper Mine with disposal of tailings to Rupert Inlet and the past disposal of tailings to Alice Arm by the Kitsault Operations and B. C. Moly. In all of this work, the only significant impact that has been identified is the direct smothering and burial of benthic organisms due to the large amounts of tailing accumulation on the fjord bottom. It was also shown in the RDEIS that the impacts to the fisheries resources would be low in either fjord system and that the differences in impacts between the two fjords is small.

In view of the absence of significant differences in the marine impacts between the two fjords, other factors should be considered. The most significant factors in support of Wilson Arm discharge include:

o Use of the Wilson Arm/ Smeaton Bay tailings disposal alternative would confine the impacts to one drainage basin, leaving Boca de Quadra pristine

o Disposal of tailings in Wilson Arm would avoid the construction of the tailings tunnel portal, drop boxes, wharf area and other disturbances in the wilderness areas along the shores of Boca de Quadra

Q-222

Mr. Edward R. Johnson
June 29, 1987

o Disposal of tailings in Wilson Arm versus the Boca de Quadra alternative would result in reduced capital and operating costs which could then result in an earlier start date for the project and more stable operations economically. The socioeconomic impact of these reduced costs could be very significant in that temporary shutdowns of the mine operation due to fluctuating molybdenum prices wculd not occur as often and wculd be of shorter duration, resulting in a more stable social structure in the Ketchikan area.

Several issues have been noted by the EPA in their preference for Boca de Quadra disposal that I feel wculd have equivalent impacts in either fjord. These include:

c The potential of suspended tailings reaching the upper water column is low and equivalent in either fjord. The major factor effecting the rise of suspended tailings is the density gradient at the pycnocline which acts as a cap on the upward movement of the high density water from the deep basins. The density gradients are similar in both fjords during the summer deep water renewal period when sufficient kenetic energy is available to suspend tailings. There is therefore no reason to believe that suspended tailings concentrations would be greater in either fjord in the upper water column.

o Active deposition will occur below the area of primary productivity in either fjord.

o The potential for heavy mental contamination of fjord waters is actually quite low in either fjord in comparison to the implied potential impacts stated in the RDEIS and BPJ for several reasons.

- the worst case copper concentration in the tailings liquid is a high value in contrast to an average number that should be used in the evaluation of long term impacts throughout the fjord

- the point (100 m from the outfall) at which the metals are considered high is within the density current where life would not be expected tc survive due to abrasion and smcthering in the high suspended solids environment. Ambient Water Quality Criteria should be compared tc metal concentrations outside the density current.

Mr. Edward R. Johnson
June 29, 1987

- significant dilution occurs beyond the point of discharge along the axis of the density current, and therefore the concentration of metals beyond the nearfield will be much less than those stated at 100 meters. This is significant in that both Boca de Quadra and Wilson Arm/ Smeaton Bay are greater than 25 and 10 kilometers long respectively

- dissolved metals in the freshwater environment of the discharge tend to naturally precipitate when mixed with seawater

- dissolved metals in the freshwater environment of the discharge also tend to adsorb to particulates when mixed with seawater

- finally, results of analysis for dissolved metals in Rupert Inlet and Alice Arm during active tailings discharge have not shown elevated levels of metals in the water column. There is no reason to believe that discharge of Quartz Hill tailings would result in accumulation of metals in the water column.

o The total area of benthic organisms smothered in the two fjords are nearly the same

o The total number of pelagic organisms exposed to the potentially suspended tailings would actually be greater in Boca de Quadra because of the much greater volume of water potentially effected.

o The risk of dissolved oxygen depleticn is minimal in either fjord.

In view of the very small differences in the potential marine impacts between Wilson Arm/ Smeaton Bay and Boca de Quadra I feel that the issues of a single basin impact, elimination of wilderness impacts from the tailings tunnel portal in Boca de Quadra, and socioeccnomic impacts from higher capital and operating costs requires that the Wilson Arm/ Smeaton Bay tailings alternative be chosen as the preferred alternative.

Sincerely,

James L. Cronin

James L. Cronin

256

DEAN LEMON
POST OFFICE BOX 415, MAMMOTH LAKES, CALIFORNIA 93546

June 30, 1987

RECEIVED
KETCHIKAN AREA
JUL 6 1987
TONGASS NF
KETCHIKAN, AK 99901

Mr. Win Green, Forest Supervisor
Forest Service
United States Department of Agriculture
Federal Building
Ketchikan, AK 99901

Dear Mr. Green:

Having been interested since its inception in the Quartz Hill project of U. S. Borax & Chemical Corporation, I wish to submit comments on the draft E.I.S. at this time.

The environmental background work that has been done and the Company's obvious complete commitment to thorough environmental protection give high credibility to their position that marine disposal of tailings in Wilson Arm is the preferable alternative to land disposal or marine disposal in Boca de Quadra. I urge acceptance of this proposal and the issuance of a permit to proceed with the project on that basis.

The positive economic impact of this project on South East Alaska and the United States, considering the well mitigated environmental impacts as the project is now proposed, do make it extremely advisable and beneficial to proceed.

Very truly yours,

Dean Lemon

cc: Mr. Robert S. Burd
Director, Water Division, Region X
U. S. Environmental Protection Agency

Colonel Wilbur Gregory, District Engineer
U. S. Army Corps of Engineers, Anchorage

Mr. Bob Grogan, Director
Office of the Governor
Division of Governmental Coordination, Juneau

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KETCHIKAN, AK 99901

ALASKA MINERALS COMMISSION
P. O. Box 80148
Fairbanks, Alaska 99708

July 1, 1987

Mr. Win Green
Forest Supervisor
Forest Service
U. S. Department of Agriculture
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

The Alaska Minerals Commission urges the Forest Service to support the preferred alternative for the Quartz Hill mining project as identified in the full mine environmental impact statement.

The modern mining industry, including large companies such as U.S. Borax, recognizes the social and environmental obligations inherent in contemporary mining operations. There is no question that the development of the Quartz Hill mine will be done carefully and responsibly. Potential environmental impacts will be closely monitored and permits will require that contingency plans be in place in the event problems occur.

As there is no significant difference between potential environmental impacts between development in the Wilson Arm/Sweston Bay and Boca de Quadra drainages, the economic advantages of Wilson Arm should be the deciding factor.

The economic stability of the project is important to the social environment of the region. The preferred alternative provides an increased level of economic security for the project as well as limiting development impacts to a single drainage.

Sincerely,

Earl Beistline
Chairman

258

1647 Onini Ct.
Bastrop, Tx 78602
June 24, 1987

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KETCHIKAN AREA
JUL 6 1987
TONGASS NF
KETCHIKAN, AK 99901

Edward Johnson
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

I am writing in regard to the revised Draft Environmental Impact Statement concerning the Quartz Hill molybdenum mine. Although your thorough appraisal of the impacts of the mine have allayed many of my concerns over the environmental impact of the project, several points have still not been adequatly addressed.

#1

First, the mine tailings will likely contain acutely toxic levels of copper, as well as substantial amounts of nickel and heavy metals such as lead and mercury. These pose substantial threats to the marine organisms, particularly anadromous fisheries, in the proposed tailings dump site. Nickel is known to be mutagenic and carcinogenic or co-carcinogenic at subacute levels. Recent studies demonstrate increasing incidences of tumors of the liver and other organs of fish within Puget Sound. Given these facts, **the Quartz Hill tailings must be considered to be a serious threat to the marine organisms in the affected environment.** The potential impact on the fisheries resource of the Wilson Arm can not be over-emphasized. ANILCA specifically requires that protection of the fisheries resource be given high priority. Therefore, the preferred disposal site for the tailings should be deep discharge into the middle basin of Boca de Quadra. Because of its greater depth, higher dilution and smaller fisheries resource, this is preferable over the Wilson Arm/Smeaton bay site.

#2

Second, the procedures for reclamation must be spelled out **in detail** prior to granting the permit. This must include measures during construction as well as operation, and at the termination of the project, to minimize erosion, provide barriers to runoff, and have active mitigation plans to cope with "accidents".

#3

Finally, given the current market conditions for molybdenum, the economic feasibilty of the Quartz Hill project must be questioned. Within the last few years molybdenum mine closures and cut backs in the lower 48 have caused thousands of miners to lose their jobs. Initiating the Quartz Hill project, only to cease production due to poor market conditions, would cause a serious disruption in the Ketchikan area economy. Because domestic demand has fallen, production from Quartz Hill would probably be exported to Asia. I recommend that the permit be granted to U. S. Borax conditionally, and that actual development of the mine complex not be allowed until prices recover to the $5.00 /lb (1982 dollars) level. We should not be exporting our sparse resources at bargain basement prices, only to pay dearly in time of shortage.

Sincerely,

Andrew P Butler
Andrew P. Butler

259

DR. DAVID L. SCHNEIDER
OPTOMETRIST
(415) 528-0105
1461 MARIN AVE.
ALBANY, CA 94706

6/29

RECEIVED
KETCHIKAN AREA
JUL 6 1987
TONGASS NF
KETCHIKAN, AK 99901

RE: Molybdenum mine at QUARTZ HILL in Misty FJORDS NAT. Monuments

Dear Mr Johnson,

I am writing this to you as a concerned environmentalist and lover of America's beautiful lands. Please support the E.P.A.'s recommendations that the Boca de QUADRA fjord be used to place the tailings after mining.

The EPA opposes the Forest Service choice of Wilson Arm, a spectacular fjord that supports one of Southeast Alaska's most important salmon runs. This fjord is not big enough and surface waters

[over]

259

will be contaminated

please protect our land.

Thank you

Sincerely,

Od Sl—, O.S.

260

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KETCHIKAN, AK 99901

30 June 1987

Mr. Edward R. Johnson
U. S. Department of Agriculture
Forest Service
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Re: Revised Draft Environmental Impact Statement
Quartz Hill Molybdenum Project Mine Development

Dear Mr. Johnson:

The above titled work required real diligence just to read and you are to be complemented on its completeness. Having been a long term residence of Ketchikan (1951-1959, 1962-1970, & 1974-1984), who has left out of economic necessity, the economic opportuntities presented by the Quartz Hill Project are tremendous. The statement regarding the Forest Service preferred alternative for tailings disposal recognizes these economic facts while being totally ignored by EPA. And job stability is in my opinion a critical issue that can be effected by requiring higher initial costs and increased operational costs. #1

I've recreated in both Smeaton Bay and Boca De Quadra. Generally, Boca De Quadra is the more interesting place with an old cannery, fish hatchery, numerous islands and beaches with interesting drift. There is evidence of previous use of the area by indians from previous cultures most noteably at the head of the inlet near the mouth of the Keta River. Whereas in Smeaton Bay the recreational moorage locations are more limited and older ruins and evidence of previous cultures is lacking. Therefore, I would like to see the final alternative for tailings disposal be Wilson Arm in Smeaton Bay. This would keep all development activities in one Bay leaving the other in its natural state. Therefore I'm in accord with the U. S. Forest Service preferred alternative. #2

Sincerely:

J. David Bonnon
19815 Yew Way
Snohomish, Washington
98290

261

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

July 6, 1987

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JUL 10 '87
FOREST SUPERVISORS OFFICE

REPLY TO ATTN OF: WD-136

Win Green, Forest Supervisor
Tongass National Forest
U.S. Department of Agriculture
Forest Service
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Green:

The Environmental Protection Agency (EPA) has reviewed the Revised Draft Environmental Impact Statement (RDEIS) for the Quartz Hill Molybdenum Project Mine Development. The RDEIS evaluates the proposed construction and operation of an 80,000 ton per day molybdenum mine and processing facility at the Quartz Hill site in southeast Alaska. The RDEIS was prepared due to several changes in project components and the availability of new data. Our review was conducted in accordance with the National Environmental Policy Act and our responsibilities under Section 309 of the Clean Air Act.

We provided comments on the preliminary RDEIS. For the most part, our concerns have been addressed in the RDEIS. However, we still have some remaining concerns. They are addressed in detail in the enclosure.

As we have previously discussed, the major issue between our two agencies is the marine tailings disposal site. Most of our review comments, therefore, relate to this issue. As the RDEIS indicates, EPA and the Forest Service will be reviewing all comments received on this subject, and selecting a preferred alternative to include in the final EIS. When the final EIS is issued, EPA will release its draft National Pollutant Discharge Elimination System permit which will reflect the EPA preferred alternative.

We are rating this RDEIS EC-2 (EC: Environmental Concerns; 2: Insufficient Information). Our environmental concerns are primarily related to the tailings disposal in Wilson Arm. The insufficient information rating is based on the lack of modeling data for a direct discharge to the middle basin, Boca de Quadra, and the need for more information about the cumulative impacts from the Intertie project and how this project could affect the decision on where to discharge the tailings. An explanation of the EPA rating system for draft EISs is enclosed for your reference. This rating and a summary of our comments will be published in the <u>Federal Register</u>.

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We appreciate the opportunity to review this document. If your staff have any questions about our comments, please have them contact Sally Brough of my staff, at (206) 442-4012 or FTS 399-4012.

Sincerely,

Robert A Burd for

Robie G. Russell
Regional Administrator

Enclosure

ENVIRONMENTAL PROTECTION AGENCY
REVIEW COMMENTS
QUARTZ HILL MINE DEVELOPMENT
REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

TAILINGS DISPOSAL

We have several comments and concerns regarding the location for the discharge of the tailings. Our comments are organized under the following subheadings; modeling efforts, tailings volume, mitigation, milling reagents and trace metals, biological impacts, and EPA's rationale for identifying the middle basin of Boca de Quadra as the preferred discharge site.

Modeling Efforts

#1

For direct discharge into the middle basin Boca de Quadra, the Revised Draft Environmental Impact Statement (RDEIS) uses, as the basis for impact analysis, the modeling results for a discharge into the inner basin. The RDEIS assumes that the flow over the sill into middle basin, following the filling of the inner basin, will behave similarly to a direct discharge into the middle basin (page 4-65). We do not believe the modeling results for an inner basin discharge can be applied to a middle basin discharge; a discharge directly into middle basin is certainly much different than an overflow from the inner basin.

#2

A discharge directly to middle basin could conceivably behave similarly to the discharge into Wilson Arm. Thus, the middle basin discharge could result in a tailings plume that looks like a combination of Figures 4-13 and 4-14, rather than like Figure 4-10. This is conceivable, particularly if the depth of the outfall is lowered to approximately 70 meters and the pipe is oriented such that the density current is directed into the deeper portion of middle basin. A direct middle basin discharge will have an active density flow in a well established channel for another 60 to 100 meters (BPJ report Appendix S, page 34).

Using the inner basin modeling results for a direct discharge to middle basin would likely overstate the adverse effects of a direct middle basin discharge, and minimize the relative differences between a direct middle basin discharge and a discharge into Wilson Arm. This should be acknowledged in the Final EIS.

#3

Finally, the discussion of how the mathematical models were used in the analysis of all alternatives is not clear. How were the turbidity and fjord circulation models coupled together? For how long a period was the fjord model run in all analyses? How were weather disturbances included in the modeling? The latter could be important in those cases where the discharge plume would be affected by surface layer dynamics. Also, it would be very useful if the uncertainty associated with the model simulations could be quantified.

Tailings Volume:

#4

An important factor to consider in evaluating a Wilson Arm discharge is the relationship of the below-sill volume to the tailings volume. We believe some uncertainty still exists regarding whether the basin will be able to contain all of the tailings to be discharged over the life of the proposed mine. Our BPJ Report (page 31) indicates that increases in total volume of deposited tailings on the order of 5 percent over those predicted in the model are possible. Any increases over the predicted volumes or an error in the sedimentation model could result in the overfilling of Smeaton Bay.

There are also uncertainties about the equilibrium slope which causes concern about tailings flow in relation to the Smeaton Bay sill. The equilibrium slope assumed for modeling is approximately 1:200. However, the observed bounds on the equilibrium slope are slopes of 1:50 to 1:200 (BPJ Report page 44). The equilibrium slope for the tailings will influence the amount of "freeboard" at the Smeaton Bay sill after 55 years of discharge. Using the assumptions made by U.S. Borax, the down fjord edge of the tailings deposit will rise to approximately 45 meters below the sill. Up fjord, the sedimentation model predicts that the top of the tailings pile will reach to about 80 meters below the water surface in Wilson Arm. This extends into the upper 100 meters of the water column which EPA concludes is most important to protect.

In conclusion, there is little margin for error in the volumetric aspect of a discharge to Wilson Arm. Small errors in the density or slope calculations could result in the tailings completely filling the below-sill volume, the tailings could flow out over the sill, or the tailings could backfill into Wilson Arm.

Mitigation:

#5

The RDEIS executive summary (page xv) states that "with appropriate mitigation there is little difference in the environmental effects of tailings disposal in the marine environment between Wilson Arm and Boca de Quadra". However, the RDEIS contains no discussion of what mitigation is proposed. None is specifically mentioned in Chapter 4 (page 4-277). Since the discharge location of the tailings is such a critical issue, the FEIS should expand upon this topic and describe what mitigation measures could be used, how feasible their implementation will be, and how effective they might be in mitigating adverse effects.

Milling Reagents and Trace Metals:

#6

Toxicity information on the organic milling reagents is insufficient to adequately assess their reaction kinetics, chronic toxicity, and environmental persistence. Of particular concern are the quartenary ammonium salt polymers which are known to be toxic at the mg/l level. Additionally, the data base for acute and chronic toxicity of the discharged mill tailings is limited and it is difficult to assess the toxic effects from long-term low-concentration exposures to the tailings and milling reagents.

#6 cont.

We agree with the RDEIS conclusion that the trace metals would exceed EPA marine water quality criteria for total recoverable concentrations near the outfall and in a turbidity plume up to 40 feet thick flowing along the bottom of the fjord. However, trace metals may also exceed EPA criteria higher in the water column when tailings are resuspended during major slumping events and if midwater plumes develop as was observed in Alice Arm for the Kitsault mine discharge. The reason(s) for these midwater plumes has not been fully explained.

Further, the RDEIS projections on metals loadings may not accurately account for dissolved metals originating from constant loading from a continuous discharge. For example, during the 1985 field monitoring at Island Copper, 10% of the dissolved copper observations exceeded EPA's acute criterion. These concentrations occurred at stations located from one-half to over nine miles from the point of discharge and at water depths from 5 to 60 meters.

We recognize that there are significant differences between the Kitsault and Island Copper sites and the Quartz Hill site. However, it is important to note that the results from those mines were not predicted in the environmental assessments of the projects. Obviously our knowledge of the physical/chemical oceanographic conditions and dynamic interactions in these fjord systems is incomplete. The behavior of the tailings for this project could also be unpredictable.

Biological Impacts:

We have several comments relating to the biological impacts associated with marine tailings disposal. They include recolonization, herring impacts and impacts on other aquatic species.

#7

With regard to recolonization, the RDEIS indicates that the tailings will be recolonized (page 4-124). Colonization of stable deposits may be rapid, but great care must be taken to not confuse "colonization" with "restoration" or "recolonization." Colonization can occur by a community that is different from pre-impact conditions. Several authors (e.g., Ellis 1975; Kathman et. al., 1984) have examined tailings after cessation of discharge and have noted that areas near the outfall had different community composition (species dominance and similarity via cluster analysis) than control areas even though certain community measures (e.g., biomass) may be indistinguishable. The ramifications of these changes for the health of the fjord ecosystem could be substantial.

#8

The RDEIS assesses the loss of herring habitat using three methods: area impacted, volume impacted and tailings plume/avoidance and reaction. The last method of assessing potential loss of herring habitat assumes that "the plume from an inner basin discharge will be similar to that of a direct middle basin discharge." As explained previously, we have serious reservations about this assumption.

#8 cont.

If a direct discharge to middle basin results in a scenario similar to the discharge to Wilson Arm, as was discussed in the modeling efforts discussion, the 1.58 km^3/yr impact on herring habitat for middle basin suspended tailings (table 4-14) could be significantly overstated. Also, there could be less impact on the bottom community above 100 meters and lower concentration of heavy metals and milling reagents in the mesopelagic zone.

#9

The RDEIS indicates that herring can be found overwintering at a maximum depth of 140 meters (page 4-126). All the literature that we have reviewed to date regarding herring and their overwintering behavior has indicated that 90 meters is the maximum depth. We would be interested in reviewing the supporting data for the 140 meter overwintering depth.

#10

Finally, in reference to other mine tailings disposal sites, on page 4-124 the RDEIS says "Buchanan (1980, page 5) states that the only commercial fishery that appeared to have decreased was the pot shrimp catch." However, Buchanan (1980 page 20) further states that there are no precise data on the crab, prawn, salmon and other fisheries in Rupert and Holberg Inlets with which a critical assessment of the commercial stocks can be made.

EPA's Rationale for Preferring Middle Basin Boca de Quadra:

The following discussion summarizes the reasons why we believe that the middle basin of Boca de Quadra is the environmentally preferable discharge location. This summary is based on the information and data that we have reviewed to date. As is stated in the RDEIS, we have not made a final decision on where the tailings should be discharged. In the RDEIS discussion on the preferred alternative we requested any additional information that could have a bearing on this decision. We will review all the comments that are received by EPA and the Forest Service before we make a final decision.

Our preference for middle basin Boca de Quadra discharge is based, largely, on the benefits from having a substantially deeper and larger basin. We believe that the middle basin:

- reduces the opportunity for tailings, heavy metals, and milling reagents to reach the upper part of the water column (water depths less than 100 m) and have physical and toxic affects on fish and shellfish or their food sources.

- reduces the opportunity for the discharge to reach and therefore affect productive estuarine habitat at river mouths.

- results in less impact to existing fjord biological and morphological (depth and area covered) conditions, therefore providing greater opportunity for the predischarge biological community to recover.

- would minimize the potential risk to the higher value salmon resource in Wilson Arm.
- would consequently have less impact to commercially important fish and shellfish.
- would provide almost certain containment of the discharge in a single basin.

COST IMPACTS FROM ALTERNATIVE TAILINGS DISPOSAL

#11

Page 2-49 describes the cost impact of the middle basin Boca de Quadra tailings disposal site versus the Wilson Arm site. While EPA does not dispute the accuracy of U.S. Borax's assignment of a price penalty of 55¢ per pound for the Boca de Quadra disposal site, it recognizes that the estimated penalty includes a number of (unstated) financial assumptions that reflect U.S. Borax's preferences rather than a forecast of market conditions. EPA would argue that the capital cost increment posed by Boca de Quadra disposal might influence the timing of project start up, but would have slight effect on operations of the mine once production had begun. Both financial and microeconomic analysis recognize the precept that in instances of reduced demand or falling price, production will continue so long as variable costs are covered. Under that construction of conditions governing intermittence of operations and adverse effects on the Ketchikan community, the marginal price effect of the EPA preferred disposal site would be 2¢ a pound for the purposes of mine shut down decisions.

WATER QUALITY

In our comments on the preliminary RDEIS, we were concerned that the measured dissolved metal concentrations were not in comparable terms to determine compliance with NPDES effluent limitations and state water quality standards. Dissolved metal concentrations were being compared directly to total recoverable and total metal concentrations. The RDEIS provides information to show how the three metal assay methodologies can be directly compared.

#12

The RDEIS calculates the total concentration of metals in the outfall discharge by adding the dissolved metals concentration to the extractable concentration from the suspended solids. We concur with this approach. However, the discussion (page E-30) indicates that iron, manganese, and molybdenum concentrations were significantly increased by adding the extractable portion. Copper is also significantly increased. The FEIS should mention this fact. Finally, the second table on page E-30 uses a mixture of acute and chronic water quality standards. Both acute and chronic values for each metal should be shown.

We have several detailed comments on water quality. They are presented below with specific page references.

#13

With regard to the impacts on Beaver Creek (page 4-33) the RDEIS states that "all of the trace metals except manganese would be diluted, within the mixing zone, below the proposed Alaska Department of Environmental Conservation (ADEC) standards." However, Table 4-4 shows that cadmium and lead exceed water quality standards at the edge of the mixing zone (Beaver Creek at the falls) for both low and average flow conditions.

#14

Similarly, the discussion about the water quality impacts on White Creek/Hill Creek indicate that water quality standards will also be exceeded for cadmium and lead (Table 4-5). We suggest that the analyses should be examined to determine if there are any mistakes. If these water quality standards will be exceeded, the FEIS should discuss the type of active control that could be used to remedy this situation.

#15

On March 27, 1987, EPA promulgated new water quality criteria for zinc (52 FR 6213). At a hardness of 100 mg/l $CaCO_3$ the acute concentration is 120 mg/l and the chronic concentration is 110 mg/l. These new zinc criteria should be updated in Tables 4-3, 4-4, 4-5 as well as the water quality tables in Appendix E.

#16

On page E-9 the reference, Haavig 1984, deals with not applying drinking water standards to the receiving waters since the receiving waters in the project area are not going to be used as a drinking water source. This approach appears to be in conflict with other ADEC actions on other mining projects, specifically placer mining permits. These permits require the permittee to comply with the drinking water standards when the receiving water is classified as a drinking water source, regardless of whether it is actually used for drinking water purposes. This issue should be reviewed with ADEC and clarified in the FEIS.

CUMULATIVE IMPACTS

#17

EPA was invited to an interagency meeting in January 1987 to discuss Alaska Power Authority (APA) plans for a Southeast Alaska Intertie System (Intertie). This system will involve a transmission line from Swan Lake (Ketchikan) to the Quartz Hill mine. While much of the system is proposed as marine cable, the Quartz Hill segment would run overland through the Misty Fjords National Monument wilderness and through the Wilson Arm watershed (non-wilderness). The overland portion through the Wilson Arm watershed is necessary because use of marine cable in Wilson Arm/Smeaton Bay is not feasible if the tailings are discharged in this location. A recent update on the project indicated that planning for the Intertie is continuing and that, of the several segments under consideration, the link from Swan Lake to Quartz Hill is one having, perhaps, the greatest potential for completion (depending of course, on the mine development).

The RDEIS does not discuss this proposed project and the impacts associated with it. We are concerned primarily with the terrestrial and visual impacts of a transmission corridor in the overland portions of the system. More specifically, if the tailings are discharged to Wilson Arm which

#17 cont.

precludes a marine transmission cable, then the discharge could have significant terrestrial and visual impacts associated with it. The terrestrial impacts associated with the Wilson Arm discharge alternative could be greater than those associated with a Boca de Quadra tailings discharge. The Forest Service preferred alternative for tailings discharge is based, in part, on the potential impacts from the tunnel portal to a 25 acre portion of the wilderness area in the Boca de Quadra drainage area.

In conclusion, the FEIS should consider the Intertie impacts. It is not appropriate to defer analysis of the Intertie project to a later date (as stated on page 2-27 of RDEIS) because: (1) the CEQ Regulations require assessment of cumulative impacts which include reasonably foreseeable future projects; (2) the Wilson Arm tailings discharge location will result in secondary terrestrial and visual effects from the Intertie; and (3) consideration of this future project could have a bearing on the current decision of where to discharge the tailings.

AIR QUALITY

#18

On page 4-2 and page C-2, the RDEIS states that the mine site would not be subject to Prevention of Significant Deterioration (PSD) review under the ADEC regulations. This statement is not correct. EPA recently determined that the EPA-approved ADEC regulations require fugitive emissions to be included when determining whether a stationary source is subject to PSD review. EPA wrote ADEC informing them that the state regulations would need to be revised before fugitive emissions could be exempted (January 30, 1987 letter from George Abel to Leonard Verrelli). Specifically, EPA indicated that ADEC could not interpret the state rules consistent with the federal regulations, since the state rules were more stringent.

ADEC is in the process of revising their PSD regulations to be consistent with the current federal regulations. Once these regulations are revised, after full public review and comment, the mine site may not be subject to PSD. ADEC has indicated that the public review period will commence in early August and a public hearing will be held in early September, 1987. The FEIS should discuss this schedule and/or the content of the regulation revisions in relation to the schedule for permitting and constructing the project.

#19

On July 1, 1987, EPA promulgated new national ambient air quality standards for particles with aerodynamic diameters of less than 10 microns (PM_{10}), and revoked the previous ambient standards for total suspended particulates (TSP). After July 31, 1987, all sources, new or existing, will have to comply with the new PM_{10} standard instead of the TSP standard. (Note that PSD sources will still need to comply with the statutory PSD increments for TSP.) The final EIS, therefore, needs to be revised to address

#19 cont.

PM_{10} instead of TSP. This will probably necessitate some remodeling of the project, or at a minimum, adjusting the current modeling results for the PM_{10} fraction of the particulate emissions and comparing to the new standards. The new PM_{10} standards are:

150 ug/m^3, for a 24 hour average concentration, not expected to be exceeded more than 1 time per calendar year; and

50 ug/m^3, annual arithmetic average, never expected to be exceeded.

#20

Regarding specific air quality concerns, average ambient particulate matter concentrations under existing conditions (background levels) are essentially pristine, in the range of 5 micrograms per cubic meter (ug/m^3) total suspended particulates (TSP). On dry days with low wind speeds (worst case conditions) mining activities at the mine site and along haul roads would result in TSP concentrations (24 hour average) slightly less than the allowable 150 ug/m^3 state standard. Although the Federal TSP standard is no longer applicable, we do not believe this change in particulate concentrations is insignificant as stated on page 4-2.

#21

Finally, the RDEIS does not evaluate visibility impairment. The Forest Service should consider using the Workbook for Estimating Visibility Impairment (EPA-450/4-80-031, November, 1980) for estimating visibility impacts on a localized basis.

WATER SUPPLY ALTERNATIVES

#22

The preferred alternative discussion (page 2-51) identifies the pool at the confluence of the Wilson and Blossom Rivers as the supplemental water supply during low flow conditions. EPA concurs with this supplemental water supply alterative. However, the discussion of the proposed project (page 2-32) identifies the Wilson River well field as the supplemental water supply. The FEIS should clarify the difference between the preferred alternative and the proposed alternative.

#23

The RDEIS was, in part, prepared to resolve questions concerning water supply for the project and the potential adverse effects of water supply alternatives on anadromous fisheries. The central concern was that it appeared that it might not be possible to maintain adequate minimum in-stream flows in the Wilson River during low flow periods. The analysis in the RDEIS suggests that this would be the case. Because of this we believe that the Wilson River well field should be ruled out as a potential supplemental water supply. The available alternatives analyses suggest that the Blossom River would be able to provide an adequate supplemental water supply.

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STATE OF ALASKA

OFFICE OF THE GOVERNOR

OFFICE OF MANAGEMENT AND BUDGET
DIVISION OF GOVERNMENTAL COORDINATION

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July 2, 1987

Mr. Michael A. Barton
Regional Forester
Alaska Region
P.O. Box 1628
Juneau, AK 99802

Dear Mr. Barton:

The state has reviewed the Revised Draft Environmental Impact Statement (RDEIS) for the Quartz Hill Molybdenum Mine Project proposed by U.S. Borax. The RDEIS addresses the deficiencies of the previous draft by substantially expanding the information base and the discussion of water supply alternatives, waste rock disposal, and tailings disposal alternatives. The state appreciates this more thorough presentation of the project.

The state believes that the Quartz Hill Molybdenum Project will be a major, long-term contributor to the regional and state economy and supports bringing it into production. Cooperation among the involved agencies and U.S. Borax must be continued to insure this is accomplished with a common sense of social and environmental responsibility.

Our recommendations are intended to support a final selection of the major outstanding project design components. Our response specifically addresses tailings disposal, water supply, and social mitigation. Additional comments in the enclosures expand on these recommendations and also represent issues generally handled by a single state agency. These include the state water quality standards, waste rock disposal, sewage disposal, air quality, and power supply. Our comments and recommendations fall within the established range of alternatives and could be satisfactorily incorporated into a final EIS. We recognize that considerably more detail will be presented as drafted permits, designed to implement the findings of the final EIS, are submitted for review. The state will continue to participate in that cooperative permitting effort under our related authories.

01-A35LH

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Tailings Disposal

The RDEIS presents two preferred alternatives for marine disposal of the mine tailings: the middle basin of Boca de Quadra (BdQ), identified by the Environmental Protection Agency (EPA) as the environmentally preferred alternative, and Smeaton Bay/Wilson Arm (SB/WA), selected as the preferred alternative by the U.S. Forest Service, (USFS).

After a full and thorough evaluation of information available on social, economic, and environmental factors pertaining to the alternative sites, the state will support disposal into SB/WA if two conditions are met.

#1 First, a monitoring program must be developed to detect divergence from predicted tailings movements and any violations of water quality standards.
#2 Second, an acceptable contingency plan must be developed to identify operational steps that would be taken if actual tailings behavior varies in some critical component from the modeling. Actions such as relocation of the tailings disposal discharge site should be included in this plan.

Our position is based on the following points.

The state concurs with the EPA's conclusion that the middle basin of BdQ is the environmentally preferable tailings disposal site because: (1) the size and depth of BdQ provides a substantial buffer for any potential variation from the modeled behavior of the tailings, (2) disposal of tailings into SB/WA will fundamentally alter the character and ecosystem of the fjord, whereas in BdQ this will not occur, and (3) the fisheries resources of BdQ are comparatively less than those of SB/WA. The state does not agree with the USFS interpretation of these points and the conclusion that there will be little difference in environmental effects between the two marine disposal sites.

Disposal in BdQ would, however, result in increased capital costs that would increases the per unit cost of molybdenum production, and make the product more susceptible to world market price fluctuations. This could have a significant impact on the economic viability of the project. It could increase the frequency and durations of shutdowns when the price of molybdenum fluctuates within a certain market range. These shutdowns will adversely effect the Ketchikan area communities.

The SB/WA tailings disposal system is also considerably less complex than would be required for BdQ, thus reducing construction impacts and susceptibility to failure. Models also show that the SB/WA site is adequate to store the tailings below the 100 meter depth.

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The state recognizes and appreciates the extensive efforts by U.S. Borax to model tailings movement and distribution in SB/WA. We believe that this modeling provides the best available prediction of the behavior of the tailings. Though we are optimistic about the advantages of the SB/WA disposal site, we are concerned that the models also indicate that there is little margin for the tailings behavior to safely vary from these predictions for SB/WA. Therefore, we believe that the demonstrated tailings behavior must be continually monitored and measured against the modeled predictions. U.S. Borax must commit to contingency actions as previously stated, and will be held finanically responsible should there by any degradation of the fishery resource as a result of activities associated with this project.

Based upon the above considerations, the state is requesting assistance and cooperation from the USFS and EPA to immediately pursue the details for developing the U.S. Borax monitoring and contingency plan for tailings disposal in SB/WA. To aid in the development of the monitoring and contingency plans, the state also requests that the USFS address the confidence levels associated with the modeling results in the FEIS. #3

Water Supply Source

The state supports the protection of the Wilson River fisheries which is provided by eliminating the wellfield alternative. A combination of water use from a dam in Tunnel Creek and withdrawal from the Blossom River, at a point downstream from fish habitat, should provide sufficient water for the life of the mine without adversely affecting the area fisheries. The state has reviewed all suggested water source combinations from Tunnel Creek and the Blossom River, considering each in light of the capital cost and reservoir capacity. We have concluded that water supplied from a reservoir behind an 80-foot dam on Tunnel Creek, in combination with a Blossom River withdrawal could satisfy the total project water demands for the life of the project. These two sources should be developed simultaneously to insure they can be managed for maximum efficiency by the full production phase.

#4

The USFS and EPA have identified a preferred alternative for water supply which includes a 110-foot-high Tunnel Creek dam reservoir as the water source for the initial production phase, and Blossom River water withdrawal as a supplemental source during the full production phase.

Borax recently responded to this identified preferred alternative by suggesting a revised alternative which allows access to the Blossom River water at the initial production phase and reduces

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#4 cont.

the initial dam height to 52 feet. A yet-to-be identified tertiary water source would be required at the full production stage. This proposal reduces the project capital costs by approximately $22 million from the RDEIS preferred alternative.

Our proposal has several advantages over the RDEIS preferred alternative and and the Borax option. It immediately addresses the long-term water demands of the milling proposal and appears to use water more cost effectively than the others. When compared with the Borax option it doubles the reservoir capacity and total milling days available during low flows with less than a proportional increase in cost, acres impacted, and material requirements. As an early sign of commitment to the efficient operation of the Blossom/Tunnel source, the state hereby requests that U.S. Borax withdraw their pending Wilson River water rights application.

The state will require that any structure which might be necessary to withdraw water from the Blossom River pool be designed to freely pass fish. Also, should minimum flows which could threaten the passage of fish be reached, water withdrawal from the Blossom River must be suspended.

Community Effects

The Quartz Hill project, though highly beneficial in terms of employment opportunities and economic growth, will present many challenges for Ketchikan, Saxman, and other nearby communities as a result of the immigration of U.S. Borax employees, their families, and others seeking employment.

The state is concerned that construction and start-up of the Quartz Hill Mine will place demands on communities in the Ketchikan area until they can "catch up" with the project-induced population surge through the provision of expanded facilities and services. Community facilities and services are in some cases already utilized at or above capacity. Short-term mine closures and associated layoffs have great potential for impact on health and social programs.

#5

It is important that U.S. Borax and affected agencies are able to reasonably respond to the anticipated fluctuation in community needs. The state is aware that we have an early eighties demographic, services, and facilities baseline against which the effects of project-induced growth can be calculated. Since the construction schedule has been delayed with no new schedule set, the data used at startup should be reexamined to determine whether, when trended out, it remains an accurate description of community conditions.

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Reductions in receipt of project-driven revenues (i.e., property and sales tax) during the "lag" phases of the project will raise the need for significant public expenditures. The RDEIS presents an overly simplistic social mitigation strategy. The fiscal situation makes it unacceptable to assume that the state or federal government will be able to fund capital projects and local operating budget increases. The allocation of costs and responsibilities among U.S. Borax, local governments, and other affected agencies must be accomplished through a negotiated settlement addressing both a process for assigning responsibility and a baseline standard for measuring it.

#6

At this point agreements must be developed between U.S. Borax, local governments, and affected agencies addressing 1) what constitutes baseline services; 2) what procedures will be used for re-evaluation of baseline service levels at project startup and 3) what responsibilities each party is willing to accept.

Thank you for the extended opportunity to comment on the RDEIS. It is a comprehensive environmental statement which can be further strengthened in final form with the incorporation of our recommendations. The state appreciates the efforts of the USFS in completing this challenging analysis.

Sincerely,

Kurt Fredriksson for

Robert L. Grogan
Director

cc: Commissioner Judith Brady, DNR
Commissioner Don Collinsworth, DFG
Commissioner Mark Hickey, DOT/PF
Commissioner David Hoffman, DCRA
Commissioner Dennis D. Kelso, DEC
Commissioner Myra M. Munson, DHSS
Commissioner Jim Sampson, Labor
Commissioner J. Anthony Smith, DCED
John Katz, Washington, D.C.
Rod Swope, Governor's Office
Robert Kendall, President, U.S. Borax
Colonel Wilbur Gregory, COE
Al Ewing, EPA

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Enclosures
Letter from Grogan to Barton
Quartz Hill RDEIS
July 2, 1987

Enclosure A - Tailings Disposal
Enclosure B - Water Supply
Enclosure C - Waste Rock Disposal
Enclosure D - Alaska Water Quality Standards
Enclosure E - Sewage Disposal
Enclosure F - Air Quality
Enclosure G - Community Effects
Enclosure H - Power Supply

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A. TAILINGS DISPOSAL

Modeling Limitations:

Field data and knowledge from active marine disposal operations have been used to generate three models to predict how tailings will behave in the marine environment. All agencies agree that the U.S. Borax efforts and investments in modeling are commendable. Modeling limitations simply reflect the state of the art.

Near Field Model-(predicts how tailings exit the discharge pipe and become influenced by the marine environment). This is strictly a laboratory study which does not include influence of currents.

Far Field Model-(predicts how a density current made up of tailings-laden seawater will flow along the fjord bottom while filling basin). This model does not include any aspect of fjord circulation. Tailings deposition is predicated without reflecting the influence of bottom currents or advection of suspended solids. Measured bottom current velocities at the intermediate sill of SB/WA could inhibit tailings deposit and increase suspended sediment concentrations in the water column.

Fjord Circulation Model-(predicts the behavior of suspended sediment). This model develops long-term trends based on averaging independent and extreme events. This model does not account for effects of winter conditions, tidal currents, or winds. Evaluation of the variability of cross, annual and vertical current movement is therefore difficult. The data cannot account for the mass balance between observed flows near the surface and flows at depth near the head of Wilson Arm.

Canadian Experience:

A considerable amount of information on marine disposal systems at other mines, particularly the Island Copper and Kitsault mines, both in British Columbia is also available. While the data at these mines is helpful, comparison between them and the Quartz Hill project has limitations. Factors such as the rate and volume of the discharge, the particle size distribution of the tailings, the reagents used in the milling process, the volume of receiving basin and the circulation patterns in the basin all influence the behavior of the tailings on a site-by-site basis. At both Canadian mines, tailings behaved differently than predicted in studies.

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Mixing Zone Considerations:

As part of DEC's certification of the eventual National Pollution Discharge Elimination System (NPDES) permit, both a mixing zone and a zone of deposit, allowed by 18 AAC 70, will be designated. These zones identify areas in which constant or frequent violations of Alaska's Water Quality Standards may occur. The department strives to designate their zones to be as small as practicable and to minimize the impact of the zones on the present and anticipated protected water uses. DEC would also choose to designate one zone to include all contaminates, rather than designate a different zone for each. The state believes that the outfall line discharge point should be as low as possible to reduce the potential for turbidity in the upper water column and minimize the size of the necessary mixing zone.

B. WATER SUPPLY

Tunnel Creek Reservoir Summary:

This table provides a brief summary of factors considered in development of the state position on water supply.

Alternative	FS/EPA	Borax	State
Dam Height (ft)	110	52	80
Dam Volume (cubic yards x 1,000)	970	310	520
Acres Covered	72	35	53
Reservoir Capacity (acre feet)	2390	530	1090
Days of Water Avail. (40,000/80,000 tpd)	58.5/29.25	13/6.5	26.8/13.4
Capital Cost* (Million $)	35	12.5	20.5
Relative Capital Cost* (Million $)	+22.5	0	+8.

* These costs do not reflect indirect capital costs which have been assumed by U.S. Borax to increase at a uniform rate of 1.5.

Flow Studies:

Data has been collected on the three water sources. In 1982 a stream gauge was installed on the Wilson River 2.1 miles above the confluence with the Blossom River. A stream gauge was installed in June 1982 about 1,000 feet upstream of the mouth of Tunnel Creek. An instream flow study on the Wilson River and Tunnel Creek was initiated at the request of the U.S. Forest Service (FS) in order to identify the habitat requirements of various fish species and the change in the habitat availability with changes in discharge. This study was completed in 1985 by the U.S. Fish and Wildlife Service (USFWS). Instream flow recommendations were developed for the Wilson River and Tunnel Creek in this study.

The state cannot support withdrawals from the Wilson River well field. The 1985 instream flow study analyses significant impacts of water withdrawals to fish habitat. The recommended instream flow requirements (225-250 cfs) during the critical winter low flows are significantly higher than U.S. Borax has presupposed in their prior analysis (100 cfs). Additional impacts to the river would also include the impacts of access road, access trails, pipelines, and bridge crossing.

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The Blossom River was gauged from February 1981 to September 1984. An instream flow study was not done. However, the four years of record show the extreme at minimum flow on record to be approximately 50 cfs. When 36 cfs are withdrawn for planned peak demands during the dry periods, 14 cfs would remain and is anticipated to satisfy the water requirements for a fish ladder. Because the spawning habitats are further upstream, the installation is not expected to have an effect on the fisheries.

#7

Preliminary field reviews suggest that during the infrequent periods of saltwater intrusion into the Blossom River pool, it may be possible for the brackish water to be pumped out and discharged by means of a bypass valve, thus eliminating the need for a weir. The state cannot adequately evaluate the proposal until the following design information is developed: Infiltration gallery and weir design specifications, if needed, (including exact weir height and fish passage mitigation measures), and additional engineering site evaluation and mapping of the saltwater wedge, to ascertain the need for a cross-channel structure.

C. Waste Rock Disposal

Large sediment ponds will be constructed to control runoff from the open pit, waste rock piles, ore crushers, maintenance area and main service area. The discharges will be required to meet NPDES effluent limitations. One of the state's primary concerns is related to the production of acid mine waste arising from biological working of the waste piles by an iron-oxidizing bacteria such as Thiobacillus ferrooxidans. The results of testing with the bacteria on samples of waste rock generated during the first seven years of operations do not indicate that an acid producing environment will be created. Therefore, elevated levels of dissolved metal leaching from the waste pile is not expected. The real world situation will introduce a number of variables that tend to promote acid production. To mitigate this potential problem, U.S. Borax has agreed to the development of a mine waste plan.

In our comments on the DEIS, DEC submitted a detailed set of criteria for the development of biomonitoring programs for the discharges from the waste rock piles. The monitoring program would serve as an early warning system to detect potential impacts on fisheries resources. The nature of upland discharges will allow for additional treatment to meet water quality standards should the monitoring program indicate a problem. In the case of Beaver Creek and Hill Creek we are considering mixing zones for the reaches of the creeks above the barrier falls. In other words, Alaska's Water Quality Standards must be met at this point in the creek. Borax has consistently committed to meeting standards at the boundary of these mixing zones.

#8

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D. Alaska Water Quality Standards:

#9

Throughout the RDEIS, the term "proposed Alaska Receiving Water Standards" is used. The use of such a term is understandable for planning purposes. The standards, however, are defined in 18 AAC 70. For example, a standard for suspended solids is listed as 20/30 mg/l when 18 AAC 70 lists the most stringent standards as "no measurable increase above background." It is important that the FS and Borax plan to adhere to the appropriate water quality standards. We also caution that DEC's decision not to identify "most sensitive indicator organisms" and drive numerical limits for toxic substances by multiplying 0.01 times the 96 hour LC50 for the organism does not preclude the use of the formula in establishing eventual mixing zones.

E. Sewage Disposal

#10

Several references are made in the RDEIS to discharges of chlorinated sewage effluents into fresh and marine waters. Although more details will be available through the NPDES review process, it is not premature to mention that DEC usually discourages both discharges into fresh water and discharges of chlorinated effluents to waters important for fish.

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F. Air Quality

On page 4-2, the second sentence states " Ambient concentrations of total suspended particulate (TSP) and SO2 must be within Prevention of Significant Deterioration (PSD) Class II increments". This is not accurate. The project will need to address, only the SO2 increment.

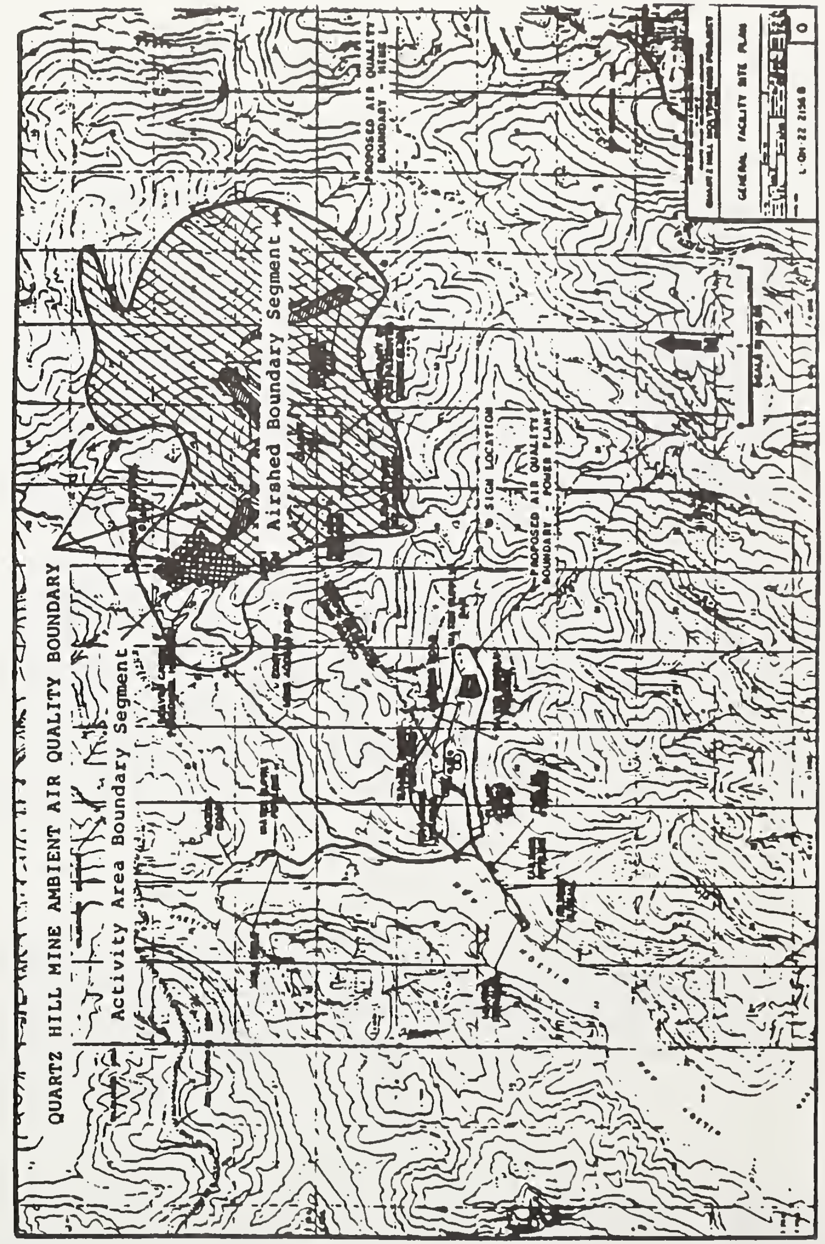
The increment for particulates has not been triggered. Consequently a review against a TSP increment under the Clean Air Act will not be needed for this project.

#11

The map used to illustrate the mine area ambient air quality boundary is incorrect. Figure 4-1 is an earlier proposed version of the boundary. A map illustrating the final boundary as determined by the Alaska Department of Environmental Conservation (ADEC) staff is attached for your use.

#12

262



G. Community Effects

#13 It is important to note that the mine is outside existing borough boundaries, so the value of the facilities will not be added to the borough tax rolls. Additional property tax revenues will derive from new construction in Ketchikan to house and support mine workers.

#14 Sections 4.3 (consequences on the Social and Economic Environment) and 4.4.3 (Mitigative Measures) make repeated reference to the availability of state grants to offset the community development costs associated with the project. For example, the second full paragraph on page 4-211 refers to a legislative appropriation for runway resurfacing and airport terminal replacement. Likewise, there are at least four measures in Table 4-44 (Socio-Economic Mitigation Measures) which identify state funding as a primary or first tier mitigation measure. References to state funding are misleading, since no guarantee exists that state funding will be available for impact studies, harbor construction, or funding of local public services. Such an assumption may have been pertinent several years ago when work began on the EIS, and state funds were more abundant, however, it is inappropriate to assume that the state will step in and shoulder local government expenses associated with construction and start-up of the project. State expenditures should not be assumed to be available simply because they are identified as a primary source for mitigation.

#15 The RDEIS does not adequately portray the effects which construction and start-up will have on city and borough finances. Resource Assessment, Inc., a firm specializing in major project development and review, estimated that mine construction, coupled with the commute option, could result in one-time capital costs of $14.5 million and an annual increase of $3.5 million in local government operating expenses. While some disagreement may exist over the accuracy of these figures, they do illustrate the fact that local budgets will be affected by the project. #16 Similarly, the amount of expected tax revenues needs to be more accurately estimated. U.S. Borax estimated their annual tax to be $5.0 million, while the U.S. Forest Service estimates the amount to be between $280.0 and $330.0 thousand. This wide discrepancy should be more fully addressed.

#17 A November 28, 1984 memorandum from the Department of Health and Social Services (DHSS) provided impact estimates for services supported during 1984. Several of the identified issues and impacts may have changed since that time, pointing to the difficulty of establishing baseline data before the actual project implementation date is known. Table 4-29 of the EIS identifies 1982 staffing for various social services and the anticipated service demand associated with operation of the Quartz Hill

#17 cont. project. This listing is also dated and will be more so when mining operations begin. A current listing and more detailed service descriptions will be required at project start-up to establish an equitable baseline for assigning socio-economic impact mitigation responsibilities.

The following comments concerning transportation impacts at Ketchikan are offered:

#18
1. The RDEIS addresses the impact on the local government concerning additional street maintenance cost to 18.3 miles of local streets. It does not, however, address the impact on the approximately 54 miles of state-maintained roads in the borough. It is felt most of the growth that will occur due to mine development will be in the borough and not the city.

#19
2. The $1,610,000 to build an additional 230 boat stalls is unrealistic. All existing harbors in Ketchikan are filled to capacity. Any construction of new stalls would require major expansion or construction of new harbor facilities. This would require additional costs to provide harbor protection dredging and other related costs.

#20
3. The Tongass Narrows Crossing Benefit/Cost Study was completed in 1985. The recommended alternative was to continue to provide a ferry link to the airport through the year 2005 with additional ferry capacity and terminal relocation and expansion as needed.

4. A new Ketchikan Transportation Study is currently in progress which will develop borough traffic projections for the next twenty years. This study will identify needs and recommended solutions to meet those needs. The completion date of this study is September 30, 1987.

H. Power Supply Alternative

The Alaska Power Authority (APA) has just finished reviewing the initial draft of a feasibility study on "Southeast Intertie" Project. This study is examining the feasibility of interconnecting several southeast Alaska communities and existing generation resources form Skagway to Juneau to Ketchikan and Quartz Hill. It also looked at the possibility of interconnections with B.C. Hydro grid in the south and Northern Canada Power Commission grid in the north.

Most of the southeastern communities have strongly supported the "Southeast Intertie" concept. In fact this was the number one priority of the Southeast Conference over the past two years. However, our recently completed initial draft indicates that most of the northern segment (Juneau-Haines-Skagway to Whitehorse) of such an intertie without any subsidies is not economically feasible at this time due to small power needs of those communities and high capital cost.

In-house evaluations of preliminary data indicate that under present economic conditions, the interconnection of all major load centers is not immediately justifiable as one project. The best approach appears to be the development of several smaller segments over a period of several years as each segment becomes financially attractive. The Juneau/Greens Creek mine segment looks particularly attractive for near term development.

The intertie draft report concludes that if and when the Quartz Hill is developed, this large load (80+MS) could easily justify construction of southern portion of this potential intertied system i.e., from Juneau (Snettisham to Kake-Petersburg-Wrangell-Ketchikan (Tyee-Swan Lake) with or without an intertie to B.C. Hydro grid. An interconnection with B.C. Hydro grid at nearby Kitsaults, B.C. would greatly enhance its benefits to Quartz Hill mine.

#21

Ed Johnson
U.S. Forest Service
Federal Bldg.
Ketchikan, AK

June 25 1987
Good News River, AK

Dear Mr. Johnson,

It has recently been brought to my attention that U.S. Borax is still hard at work destroying public land and public fisheries in the heart of Misty Fjords National Monument. It is an area I am intimately acquainted with, having spent many months exploring all its nooks & crannies. I'll always consider myself fortunate to have seen it before Borax began ripping it up. Unfortunately my children will not have that option.

More specifically, I would like to know why the Forest Service has bowed to U.S. Borax demands to dump tailings in Wilson Arm? I find it hard to believe that it is in the public interest to [illegible] risk harming some of Southeast Alaska's most productive fish runs in order to save U.S. Borax a few dollars. I seriously doubt whether it is in the long term economic interest of the Ketchikan area or the rest of SE Alaska either. If tailings are to be dumped anywhere it should be in [illegible] and not Wilson Arm, but I don't believe they should be dumped in either. [illegible]

rivers draining into both arms support important salmon runs. If US Borax wants to mine this deposit why can't they develop an on-land dumping area that will not leach into the waterways of the Blossom, Keta, & Wilson drainages? It will undoubtedly be an incredible eyesore & have its own impacts, but not as serious as the ones that will entail from dumping in ~~the~~ Wilson Arm & Boca de Quadra. #1

I also strongly oppose proposals for water well fields in the Wilson drainage or any other proposal that would interfere with water flow, water level, or fish passage into these drainages.

Those of us who have lived in SE Alaska for any length of time can not help but wonder when the Forest Service is going to do its job of managing for multiple use including the protection of fish, wildlife, & recreational resources for long-term sustainability, and stop pandering to large corporations which should consider themselves fortunate to have the use of public lands for their own private gain.

I also find the Forest Services continuing rhetoric on the need to create more jobs for SE Alaskans unconvincing. Such utter disregard for the renewable resources ~~of the~~ ~~[illegible]~~ of SE and their long-term sustainability as the Forest Service has [illegible] shown is only likely to hurt the long-term economic health of the area. Besides, the Forest Service is not an employment agency, nor is it supposed to be a servant of large, private corporations.

I strongly urge you to reconsider any plans to dump the Borax mine tailings in ~~the~~ Wilson Arm or Boca de Quadra. I also urge increased efforts on your part to protect the fisheries, wildlife & forest resources of the area, and less concern for the profits of Rio Tinto Zinc.

Sincerely,

Mary V. Hausler
P.O. Box 90
Bethel, AK 99559

264

A.W. BRINDLE
H.A. BRINDLE

PACKERS OF
CHOICE ALASKA SALMON

Wards Cove Packing Co., Inc.

BOX C-5030, UNIVERSITY STATION
88 E. HAMLIN STREET
SEATTLE, WASHINGTON 98105-0030
PHONE (206) 323-3200

ESTABLISHED 1912

July 6, 1987

RECEIVED
JUL 9 '87
FOREST SUPERVISOR'S OFFICE

Edward R. Johnson
Interdisciplinary Team Leader
Tongass National Forest
Federal Building
Ketchikan, AK 99901

Dear Mr. Johnson:

I wrote you a letter on October 2, 1984, expressing some of my concerns over the impact of the Quartz Hill Molybdenum project on fish production in Smeaton Bay - Wilson Arm. In the recently published Draft Environmental Impact Statement, Comments and Responses, I do not find much satisfaction to my queries so I need to restate the very central question of the value of the affected fisheries resources.

I do not believe that an open pit mine, 2 miles long and 2 miles wide, with a potential depth of 1,875 feet and employing a work force of 1,000-1,500 people, will not drastically and adversely change marine and fresh water life during the projected 55-year life of mining operations. This is the price of exploiting non-renewable resources. Examples can be drawn from almost any country in the world.

#1

Rational decisions can only be made if the true value of the affected renewable resource has been established over a 55-year period since this is done for the assumed benefits from mining operations. Let me again stress that one must do so based on the potential value of a renewable resource. The averaging method of past counts is not acceptable. The upward trend in production is due to better management and certain climatic trends. Further, a stock of salmon possesses a site-specific genetic characteristic which is expressed as its fitness function. Nowhere do I find that these problems have been dealt with at depth.

#2

I observe that the same is basically true for the probabilities of adverse occurrences taking place. It is highly unsatisfactory to say that the probability is small. I grant that for many events it is difficult to assign a probability. It, therefore, becomes imperative to use probabilities of the worst case in order to bound the underlying risk function. Unless such a function is developed, it will be a constant source of discussion when mitigating measures should be instigated. I have failed in finding any discussion of proposed monitoring activities.

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-2-

#2 Cont.

A number of measures have been listed in Table 4-43. But, performance of spawning channels, egg incubation boxes, etc., has been variable. Creation of intertidal habitat is largely untried, and the studies conducted did not address the question of the importance of intertidal habitats for survival in a quantitative manner.

I realize that the value of the renewable fisheries resources probably is not of the order of that accruing from the proposed mining operation, but as one of the many who will suffer and experience some form of economic hardship, I am entitled to know the true cost of such damages and the probabilities that various scenarios may materialize. This must be expressed mathematically and cannot be brushed off by general, broad-sweeping statements.

#3

Very truly yours,

Alec W. Brindle gb

Alec W. Brindle
Signed in Mr. Brindle's absence

AWB:gb

cc: Senator Ted Stevens
Senator Frank H. Murkowski
Congressman Don Young

265

United States Senate

COMMITTEE ON APPROPRIATIONS
WASHINGTON, DC 20510-6025

June 30, 1987

1) LMW #139 AC...
2) RF/DRF FOR SIG...
cc Ketchikan
1/

Mr. Michael Barton
Regional Forester
U.S. Forest Service, Region 10
P.O. Box 1628
Juneau, Alaska 99802

Dear Mike:

I understand that the plans for disposal of tailings from the Borax Quartz Hill project have generated quite a bit of public comment. After considering the alternatives, I want to express my support for disposal of the mine's tailings in Wilson Arm/Smeaton Bay.

Based on the conclusions of the Revised Draft Environmental Impact Statement you have prepared, the expected impacts of tailings disposal in either arm appear nearly equal from an environmental perspective. It seems that Boca de Quadra would simply provide more insurance against unexpected events than would Wilson Arm. This should be weighed against the fact that tailings disposal in Boca de Quadra would involve facilities in two drainages instead of one. Economics aside, it makes sense to avoid unnecessary development inside the wilderness area when a structure outside the wilderness area would do the same job with about the same effects.

At the same time, there is a serious economic consideration in making this decision. Tailings discharge to the middle basin of Boca de Quadra would have a significant adverse impact on the economics of the project. Tailings disposal in Wilson Arm, rather than Boca de Quadra, could reduce capital costs by $59 million and annual operating costs by $1.6 million. This is estimated to be equivalent to 55 cents per pound of molybdenum produced -- very significant when compared to a present market price of $3.25 per pound.

Based on these considerations, Wilson Arm seems to be the logical choice for tailings disposal.

With best wishes,

Cordially,

TED STEVENS

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Q-243

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United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240

ER 87/510

JUL 28 1987

RECEIVED
KETCHIKAN AREA
AUG 3 1987
TONGASS NF
KETCHIKAN, AK 99901

Mr. Edward R. Johnson
Interdisciplinary Team Leader
Tongass National Forest
Federal Building
Ketchikan, Alaska 99901

Dear Mr. Johnson:

We have reviewed the revised Draft Environmental Impact Statement (EIS) for the Quartz Hill Molybdenum Project Mine Development, Tongass National Forest, Alaska, and offer the following comments. The Department recognizes the importance of the Quartz Hill molybdenum deposit. Molybdenum is a valuable and strategic asset to the industrial, military, and economic interests of the United States. Worldwide, most molybdenum is recovered from deposits having grades averaging 0.2 percent to 0.5 percent molybdenite (MoS_2). Quartz Hill's 1.5 billion tons of ore include 200 million tons of readily accessible ore grading 0.2 percent MoS_2 with an average of 0.14 percent for the entire deposit. Quartz Hill is expected to produce roughly 10 percent of the world's production and has 2.5 billion pounds of contained molybdenum. This is in contrast to the USSR which has 1.5 billion ponds of reserves and produces 17% of the world's supply.

The Quartz Hill project would diversify and strengthen the economy of Ketchikan and surrounding communities, increase and stabilize the economy of Alaska by broadening its industrial base, and contribute to the national balance of payments by providing a dependable source of molybdenum for the Pacific Rim and other markets.

In our opinion the Forest Service's preferred alternative is generally acceptable. We, however, wish to emphasize two environmental issues: 1) the location of tailings disposal; and 2) the source of water for processing.

<u>Tailings Disposal</u>

The company's preference is to dispose of tailings in the Wilson Arm of Smeaton Bay, which would save an estimated $59 million in capital costs and $1.6 million per year in operating costs. In addition, tailings disposal in Wilson Arm/Smeaton Bay, with its lower capital and operating costs, could result in other benefits such as the ability to start production at an earlier date, reduction of investment risks, and the reduction of risks of shutdown during periods of low metal prices, thus lessening associated local, State, and national socioeconomic effects.

#1

Because the Wilson Arm area has greater fish and wildlife resource value than Boca de Quadra, there is a significantly greater potential for adverse impact on fish and wildlife resources. The Forest Service, however, has not fully addressed these impacts nor have appropriate mitigation and follow-up monitoring been explicitly proposed. It appears that only the "best case" situation has been considered without regard to mitigation

#1 which may be necessary in the event the assessment is incorrect. The final environmental impact statement (EIS) should identify what mitigation measures would be implemented if fish and wildlife resources are adversely impacted.

The draft environmental impact statement (EIS) states that with appropriate mitigation there would be little difference in effects of tailings disposal between the two basins. Most measures referred to in Table 4-43 appear to be compensation measures. We believe, however, that greater emphasis, should be placed on avoidance or minimization of impacts.

Water Supply for Processing

#2 The Wilson River is one of the major producers of salmon in southeastern Alaska. To protect this resource, the Department of the Interior supports the Forest Service preferred alternative which would utilize the Tunnel Creek watershed as the processing water source. We recommend that the proposed storage reservoir on Tunnel Creek be sufficiently large so as to minimize the requirement for pumping water from the deep scour hole at the mouth of Blossom River. The reservoir should also be designed to maintain the necessary instream flow requirements of salmon in Tunnel Creek.

Development of a pumping station for the purpose of diverting water from the Blossom River should be deferred until essential to operation of the mill. With increased storage capacity in the proposed Tunnel Creek Reservoir and reduced processing levels, interim water requirements for milling and instream flows for salmon habitat protection could be provided by water from the Tunnel Creek watershed.

When needed, water diversion from the Blossom River should be accomplished by the use of pumps, adequately screened to prevent impingement on or entrainment of juvenile salmonids. No modification of the Blossom River stream channel to minimize salt water intrusion into the scour hole should be permitted. Because of the close proximity to salt water due to occasional extreme high tides, saltwater intrusion could be expected to occur several times each year. Such events are predictable. Saltwater trapped in the scour hole during extreme high tide events could be pumped from the pool and shunted back to the river, downstream from the pump station. The total amount of time involved from the beginning of salt water intrusion until the system is purged would be less than six hours.

Water Quality

#3 The EPA general criterion of 2.9 parts per billion (ppb) of soluble copper as a level of "acute toxicity" should be thoroughly investigated for applicability at specific sites. That concentration may not always be toxic to the varieties of fish and marine life at a given location.

Power Generation

#4 The Forest Service preferred alternative specifies onsite power generation only. However, an intertie and purchase of hydropower from a utility in British Columbia could affect a considerable long-term saving, materially reduce the hazard of oil spills and

Q-244

#4 reduce air, particulate and noise pollution. Environmental objections to an overland power line might be overcome by using new direct current technology and a submarine cable from Prince Rupert. In an earlier review, the Alaska Power Administration cited reconnaissance studies that indicate that the underwater alternative may be economically and environmentally competitive with the overhead transmission alternative.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

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KETCHIKAN GATEWAY BOROUGH
344 Front Street
Ketchikan, Alaska 99901
(907) 225-6151

TO: David G. Crow, Borough Manager

THRU: William D. Jones, Planning Director

FROM: Peter Dragovich, Associate Planner PD

DATE: May 26, 1987

RE: Borax RDEIS - Growth Location Assumption

#1

The RDEIS states that 80% of the population growth due to mine development will occur in the City of Ketchikan and attributes this assumption to "the Borough Planning Department." The planning department was not the source of this assumption and we have not calculated what this percentage should be.

The misunderstanding on the source of the 80% figure can be traced to a phone conversation with an Envirosphere researcher when the issue of housing units was discussed. We were discussing several assumptions one being that 90% of the multi-family housing to be built during mine development would occur within the City of Ketchikan and that the city's percentage of all single family homes would probably rise to 70% from 65%. The Envirosphere researcher then said, "so you would say about 80% of the growth would occur in the city?", to which I replied, "whatever the percentages work out to." It is obviously not correct to directly average the 90% and 70% figures we were speaking of to arrive at an overall 80% growth allocation. For one, multi-family housing represents only 27% of all existing units. A 5% rise in the percentage of all single family units in the city to 70% would also not transfer to mean that 70% of all new units would be built in the city. Calculations must be included regarding expected increases or decreases in the importance of multi-family units during mine development and, for purposes of estimating population growth, person per household figures by housing type should be included. The correct response to the question was, "whatever the percentages work out to" and Envirosphere did not bother to carry through with the necessary calculations.

The 80% assumption is a very important part of the EIS socioeconomic section. It drives many impact estimates, particularly on public services. When the DEIS came out I marked in large red letters on page 4-159 "where did this come from?", when first encountering the 80% figure. While technical corrections will always need to be made as real

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#1 Con't

world conditions change, this growth allocation assumption is central to estimating impacts and is at a level of importance above the technical details contained in the RDEIS. I do believe that the RDEIS consultants must recalculate the growth location assumption.

PD:cw
052202-3

C1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Juneau Fish and Wildlife Enhancement
Southeast Alaska Ecological Services
P. O. Box 021287
Juneau, Alaska 99802-1287
(907) 586-7240

IN REPLY REFER TO:
8/SEES/vv

RECEIVED
JUN 30 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

June 26, 1987

Colonel Wilbur T. Gregory, Jr.
District Engineer, Alaska District
Corps of Engineers
Pouch 898
Anchorage, AK 99506-0898

Re: NPACO NO. 071-OYD-2-840015
Smeaton Bay 5

Dear Colonel Gregory:

The U.S. Fish and Wildlife Service (Service) has reviewed the referenced public notice dated June 3, 1987. United States Borax and Chemical Corporation (U.S. Borax), on behalf of the Pacific Coast Molybdenum Company, has requested a Department of the Army permit (permit) to develop their Quartz Hill Molybdenum Project 45 miles east of Ketchikan, Alaska, within the Misty Fjords National Monument.

U.S. Borax proposes to construct a marine terminal, access roads, water supply facilities, tailings outfall, sediment control dams, mine personnel housing, mine service facility and a temporary log transfer facility. A detailed description of project features and specific construction methods are contained in the public notice.

This report provides the Service's position on the specific proposal contained in the referenced public notice. It is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e) and constitutes the official report of the Department of the Interior. This and previous documents have been provided to your agency for use in determining proposed project compliance with the Environmental Protection Agency's Guidelines For Specification of Disposal Sites For Dredged or Fill Material (40 CFR 230) (404(b)(1) (guidelines), and in the public interest review (33 CFR 320.4) as these processes relate to project impacts on fish and wildlife resources. In addition, this report is consistent with the requirements of Titles I and V of the Alaska National Interest Lands Conservation Act as they relate to this proposal and the protection of affected fish and wildlife resources. Since the Revised Draft Environmental Impact Statement was distributed for review at the same time as your public notice, changes could be made to the preferred alternative during preparation of the final Environmental Impact Statement. If substantive changes occur to the proposed project, we request the opportunity to provide additional comments. It is likely that a revised public notice would also be necessary. #1

The fish and wildlife resources potentially impacted by the proposed project have been comprehensively described in various documents, including the current Revised Draft Environmental Impact Statement issued by the Department of Agriculture. We will not repeat those descriptions here, however, the following is a summary description of such resources and their habitats.

The project area includes a wide array of habitats, from alpine to riparian, wetlands to riverine, and estuarine to deep benthic. The entire area was pristine prior to the applicant's exploration activities and habitats potentially impacted by the project can be considered naturally optimum relative to their respective faunal assembladges. The estuarine tide flat at the head of Wilson Arm is a habitat type that is in relatively short supply in Southeast Alaska. Such habitat is biologically important, supporting eelgrass and Dungeness crabs as well as a variety of shorebirds and waterfowl. Shallow intertidal zones of this type are well documented as among the most productive of all habitat types. Representative species in terrestrial areas include, but are not limited to, mountain goat, black bear, brown bear, bald eagle, and various fur bearers. Salmon, trout, char, other fishes and various other aquatic species are found in freshwater habitats. Estuarine and marine habitats support eagles, waterfowl, bivalves, crabs, shrimps, herring, salmon, marine mammals, and various bottom fishes.

Some of these organisms are used for human consumption, both commercially and recreationally, while a myriad of other species are of inestimable scientific, esthetic and sociological value. Additionally, the bald eagle is a specially protected species of national importance. The average harvest of salmon from the project area represents 12 percent of the total catch from the Ketchikan area during the period from 1975 to 1982. Salmon produced in the Wilson-Blossom River systems contributed in excess of seventy-five percent of the catch in the project area. Only 34 out of approximately 4,750 designated anadromous fish streams in Southeast Alaska support chinook salmon runs, and over one-third of those are located in Misty Fjords National Monument. Chinook salmon represent a valuable sport and commercial species.

During application of the Fish and Wildlife Service Mitigation Policy, we have selected chinook salmon, Tanner crab, Dungeness crab, eelgrass, mountain goat and black bear as our evaluation species for this project. We have categorized aquatic habitats in the project area supporting chinook salmon, and alluvial delta type intertidal areas as Resource Category 2 because of their high value and national scarcity. Our mitigation goal for Resource Category 2 is to ensure no net loss of in-kind habitat value. Based on our analysis of species density, habitat utilization and quality, we have classified all other habitats including terrestrial habitats and deep benthic habitats as Resource Category 3. Our mitigation goal for Resource Category 3 is to ensure no net loss of habitat value while minimizing loss of in-kind habitat value.

During our review of the proposed project, we identified major items which need to be addressed before issuance of a permit. If these major concerns are satisfied, most of the specific issues associated with individual project features will also be addressed. The following describes the major issues.

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Neither the public notices nor the Revised Draft Environmental Impact Statement in Section 4.4 Mitigative Measures contain a definitive mitigation plan detailing mitigation measures necessary to offset project impacts. The Environmental Impact Statement states that "measures" are to be instituted at a later stage of the project and that a resource advisory group is to review results of ongoing studies and monitoring, assess impacts of activities on the natural resources of the area and identify appropriate mitigative measures. The project must contain appropriate mitigation as part of project plans before it is approved. The Council on Environmental Quality Regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR 1500-1508) provide for identification of all reasonable mitigation measures to mitigate adverse environmental impacts (Sections 1502.16(h) and 1505.2(c)). Also these regulations require (Section 1505.2(c)) that the Environmental Impact Statement and the Record of Decision indicate the likelihood that such measures will be implemented. Mitigation, if not incorporated into the project either during design or construction phases, may be difficult to achieve and needlessly expensive if it must be retrofitted after the project is completed or operational.

#2

Prior to permit issuance, a comprehensive Mitigation Plan must be prepared by the applicant in consultation with State and Federal resource agencies and the Corps of Engineers. The Mitigation Plan must be made a part of the Department of the Army permit issued for this project. The Mitigation Plan should contain the following elements 1) specific mitigation measures to be implemented during project construction and operation which include but are not limited to provisions to address avoidance of avoidable impacts, compensation of unavoidable impacts, maintenance of water quality, instream flow requirements, impacts to fisheries, impacts to marine resources, etc.; 2) a Monitoring Plan to assess the effectiveness of implemented mitigation measures, assess disposal of tailings and to identify unanticipated impacts; 3) a Contingency Plan whereby the District Engineer, after consultation with State and Federal resource agencies will implement modification of ongoing mitigation, or require additional mitigation measures if impacts are identified by such agencies; 4) a Bald Eagle Protection Plan; 5) a Spill Prevention Control and Countermeasures Plan and 6) a Rehabilitation/Revegetation Plan. Other major elements may be identified during preparation of the Mitigation Plan which should be included.

The applicant has described potential mitigation measures in the Revised Draft Environmental Impact Statement which can be used in preparation of the mitigation plan; however, no decision has been made as to which if any of these measures will be accomplished. Some of the measures listed to mitigate impacts to freshwater fisheries included: gravel cleaning, incubation boxes, spawning channels, fishways or barrier modifications to provide for fish passage to unused habitats, maintenance of instream flows, flushing flows, erosion/sediment containment structures and a controlled blasting program. Measures proposed in the Revised Draft Environmental Impact Statement to mitigate impacts to the marine environment included: creating a tidal marsh and an artificial reef, and obtaining additional information on the chronic toxicity of tailings. Monitoring also was proposed.

a1

In addition, the incorporation of mitigation for unavoidable impacts on fish and wildlife resources is critical to a finding of compliance with the 404(b)(1) guidelines. Appendix O purports to do this in subparts B and H (Compliance with Guidelines, and Action to Minimize Adverse Effects, respectively); however, it is woefully inadequate. The 404(b)(1) evaluation only refers to various sections in the Revised Draft Environmental Impact Statement and does not provide an analysis of the project as required by the guidelines. Subpart B states in part, "Appropriate and practical steps have been identified in Section 4.4 of the Revised Draft Environmental Impact Statement which would minimize potential adverse impacts of the project on the aquatic ecosystem. These mitigation measures would be incorporated into the project design or would be required by permit conditions or other agreements."

However, the Draft Revised Environmental Impact Statement, subsection 4.4, contradicts this statement as follows:

> ..."The discussion is conceptual for most measures, including those measures to be instituted at a later stage of the project. The methodology is specified only in general terms because technologies change."
>
> "A resource advisory group consisting of individuals from the various organizations represented on the interdisciplinary team for this project will be formed to provide advice on permit preparation and administration, and to review results of on-going studies and monitoring, assessing impacts of activities on the natural resources of the area. Further, they will provide advice relative to the need for mitigative action and identify appropriate mitigative measures, as circumstances dictate."
>
> "The formation of the resource advisory group in no way relieves any state or Federal agency of the responsibility or authority to issue and administer its permits."...(Emphasis added.)

#3

It appears that the "avoidance" aspect of mitigation is being ignored: and, while a definitive plan of development is proposed, mitigation for project-induced impacts is "conceptual" only. A 404(b)(1) guidelines compliance determination cannot be made for this project until specific mitigation measures, incorporating the spectrum of techniques from avoidance through compensation, as specified in 40 CFR 1508.20 and in the order found therein, are incorporated into the permitted project design, the existence and functioning of a "resource advisory group" notwithstanding.

In addition, since the proposed project is comprised of numerous components the following is an individual evaluation the impacts of those features and the associated mitigation needs.

Mine Personnel Housing: The housing for mine personnel is to be constructed on a rock fill placed in approximately ten acres of muskeg wetlands resulting in an unavoidable loss of that habitat type. Appropriate mitigation should be identified in the Mitigation Plan. Also, the site should be rehabilitated on termination of the project in compliance with the Restoration/Revegetation Plan.

c1

Mine Service Facility: The service facility for the mine is to be constructed on a level pad, a portion of which will be rock fill placed in muskeg wetlands resulting in a habitat loss. Measures should be included in a Mitigation Plan to offset impacts due to construction of the mine service facility. We are also concerned with potential spills from probable storage, distribution and use of petrochemicals and other pollutants. A Spill Prevention Control and Countermeasure Plan should be prepared in consultation with State and Federal resource agencies to ensure that appropriate actions are taken in the event of a spill. Also, the mine service area should be rehabilitated in accordance with a Restoration/Revegetation Plan.

Sediment Control Dams: These dams are proposed in Upper Beaver Creek, White Creek, and Hill Creek drainages to trap sediments carried in run-off from deposited overburden and waste rock. A portion of the dams and wasted materials will be placed on muskeg and riverine wetlands resulting in a loss of these habitats. Water-courses will be temporarily impounded during construction and will temporarily degrade water quality. Sedimentation and/or siltation could occur in fish spawning beds, fish rearing areas and overwintering areas. Mitigation to offset lost habitat values should be included in the Mitigation Plan. Water quality must be maintained throughout the life of the project and rehabilitation of these facilities will be necessary in accordance with a Restoration/Revegetation Plan. The sediment control dams must be designed and maintained to treat the water inflow or runoff from disturbed areas from a 10-year, 24-hour precipitation event. Detention time within the pond should be a minimum of 10-hours until it can be demonstrated that water quality standards for suspended sediment can be complied with with lesser detention time. Sediment control dams should also be designed with a combination principal and emergency spillways to safely discharge the runoff from a 25-year, 24-hour precipitation event. Sediment dams may require periodic cleaning and disposal of sediment material at an approved site to maintain the specified minimum retention period.

Log Transfer Facility: A temporary log transfer facility is proposed on the shore facility which is currently being used for U.S. Borax activities. The transfer site is for removal of timber cleared for project development and it is proposed within the area of the proposed marine terminal. The transfer of logs at this site will result in the loss of bark into intertidal and subtidal habitats. To avoid the accumulation of bark into these habitats, all such material and other debris must be removed periodically and deposited in an approved upland site. However, if the specific log transfer facility location is within that area of the marine terminal proposed for fill, removal of bark would only be necessary to prevent it from entering marine waters. In addition, the rafted logs must be located in an area of at least -40 feet mean lower low water to minimize adverse impacts to subtidal habitats in accordance with the Governor's Timber Task Force Guidelines.

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Marine Terminal: The proposed marine terminal is to interface project operations with marine and air transportation systems. It includes berthing for various vessels, boat ramps and a marina, a helicopter pad, oil transfer apparatus, a terminal building, a warehouse, parking, run-off and emergency spill retention ponds, a waste water outfall pipeline, a temporary floating camp and a log rafting boom. Approximately 12,900-cubic yards of rock fill would be placed below high tide line for the boat ramp and barge berth. The remainder of the terminal proper below the high tide line would be pile-supported. Marine habitat impacted is intertidal with a rock/bedrock substrate supporting a typical rockweed/barnacle assemblage. Impacted upland habitat includes rock and forest. Nearshore construction would require blasting of rock substrate and could adversely impact migrating juvenile salmon if done during the period of May thru July. Blasting must be avoided during that interval. All other mitigation measures should be described in an approved Mitigation Plan.

In addition, there is a potential for spills from the transfer, handling and storage of petrochemical products and other hazardous materials. The areas at risk from a spill include all nearshore and offshore habitats including the nearby alluvial delta-type estuarine intertidal area. Appropriate mitigation measures must be described in an approved Spill Prevention Control and Countermeasure Plan prepared in consultation with resource agencies. Rehabilitation of the area on termination of the project must also be done in compliance with the Restoration/Revegetation Plan.

Access Roads: The applicant proposes to widen the existing mine access road during mine development. In addition, other access roads are proposed to serve the mill area and the water well field proposed in the Wilson River. A bridge is also proposed across the Blossom River for well field access. The types of habitat which would be impacted include forest, intertidal, muskeg wetland, stream bed and estuarine. Road construction and erosion could result in deposition of sediments into stream channels resulting in adverse impacts to chinook and other salmon spawning and rearing habitat. A controlled blasting program during construction would minimize the potential for landslides and erosion into watercourses. Also, mitigation measures should include measures to control sediment deposition into waterways, gravel cleaning to remove sediments and rehabilitation of all roads in accordance with the Restoration/Revegetation Plan.

Water Supply Well Field, Pipeline, and Dam: The applicant proposes to develop a well field in the Wilson River, pipe the water to the mill area, and develop a reservoir to store the water. The well field would be located in Wilson River gravels and the pipeline for transporting the water is proposed to parallel the access roads from the well field to the mill area through forest habitat. The proposed dam would be placed on Tunnel Creek above salmon spawning habitat.

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The Wilson River is one of the major producers of chinook, pink, chum, and coho salmon in southeastern Alaska. Disturbance of the spawning gravels in the Wilson River and, in particular, the withdrawal of water during low flow conditions would adversely affect its productivity. In particular, existing low flows are critical to rearing and survival of incubating salmon eggs. Consequently, the Service opposes development of a well field in the Wilson River drainage and recommends utilization of the Tunnel Creek watershed as the primary water source. Therefore, the Blossom River bridge and the road from the bridge to the Wilson River well field would not be necessary and should be eliminated from the proposed project. However, if in spite of these impacts the Wilson River is utilized as a supplementary water source, then instream flows of 600-cfs for July 1 through September 30, 225-cfs for October 1 through March 31, and 250-cfs from April 1 through June 30 must be maintained or exceeded. A stream guaging station with remote telecommunications capability would be required on the Wilson River so that instantaneous discharge may be monitored from Ketchikan. Furthermore, if supplemental water from the Blossom/Wilson system were allowed to discharge into the Tunnel Creek system, it could adversely affect salmon produced in the Blossom/Wilson system, as they could then home in on Tunnel Creek. Therefore, water from the Blossom/Wilson rivers must not be discharged into Tunnel Creek.

The proposed storage reservoir on Tunnel Creek must be designed large enough to minimize the requirement for pumping water from other water sources. The reservoir must also be designed to maintain the necessary instream flow requirements of salmon in Tunnel Creek which is 90-cfs from July 1 through November 30, 15 cfs from December 1 through May 31, and 30-cfs from April 1 through June 30. The water supply reservoir should be designed with a combination principal and emergency spillways to safely discharge the runoff from a 25-year, 24-hour precipitation event.

The Blossom River water supply alternative provides a dependable supplemental water source as well as minimizing impacts upon fisheries. Water diversion from Blossom River should be accomplished by the use of pumps that are adequately screened to prevent impingement or entrainment of juvenile salmonids. Utilization of an infiltration gallery is the preferred method of water withdrawal. The Blossom River stream channel should not be modified to minimize salt water intrusion into the scour hole because it is not necessary and upstream migration of salmon could be adversely impacted.

C1

Tailings Outfall and Associated Facilities: The applicant proposes to discharge tailings into the Smeaton Bay/Wilson Arm. Tailings would be transported from the mill through a pipeline paralleling the access roads and terminating about 1/2 mile seaward of the marine terminal in 150 feet water at mean lower low water. A seawater mixing chamber would be included in the pipeline just as it enters the fjord at the seaward end of the marine terminal. Wilson Arm has significantly higher fish and wildlife resource values than Boca de Quadra. Therefore, the potential for significant adverse impacts upon such resources are substantially greater if disposal occurs there rather than in Boca de Quadra. Tailings disposal would cause significant changes in bathymetry and circulation which may result in suspended material in the water column thereby affecting all species inhabiting or migrating through these waters. The Revised Draft Environmental Impact Statement specifies that more information is needed to show that milling reagent toxicity is not a problem. Section 505(b) of the Alaska National Interest Lands Conservation Act requires that the project prevent significant adverse environmental impacts to fishery habitat. Since Boca de Quadra is deeper and larger, it would be more suitable as a disposal site. Therefore, the Service recommends that the middle basin of the Boca de Quadra Fjord be used for mill tailings disposal.

If, in spite of the potential for resource loss, tailings are deposited into Wilson Arm, a monitoring program must be implemented to identify if water quality and biological resources are impacted. The Monitoring Plan must be prepared in consultation with State and Federal resource agencies. Also, a Contingency Plan must be prepared with these same agencies to identify measures to be implemented should such impacts occur. Possible contingency measures could include, but not be limited to, moving the outfall or stopping disposal of tailings to Wilson Arm and discharging to the inner basin of Boca de Quadra Fjord.

In conclusion, the Service finds that the project, as proposed, would have significant needlessly adverse impacts upon important fish, wildlife and their habitats. Therefore, the Department of the Interior objects to issuance of a permit unless the following project modifications and permit conditions are included:

#4 1. The applicant shall prepare a comprehensive Mitigation Plan in consultation with State and Federal resource agencies and the Corps of Engineers. The Mitigation Plan shall be made a part of the Department of the Army permit and shall include the following:

#5 a) specific measures to mitigate impacts due to project construction and operation;

#6 b) a Monitoring Plan to assess the effectiveness of mitigation measures, assess the disposal of tailings and identify unanticipated impacts;

#7 c) a Contingency Plan for unpredicted impacts which may result from landslides, hazardous material spills, tailings disposal or for any other unexpected reason whereby the District Engineer, after consultation with resource agencies, will require implementation of modified or additional mitigation measures;

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#8 d) a Bald Eagle Protection Plan to avoid adverse impacts upon eagles and their nesting and feeding habitats;

#9 e) a Spill Prevention Control and Countermeasure Plan to assess potential hazards, identify appropriate actions and require that necessary personnel and equipment be maintained on site;

#10 f) a Water Quality Control Plan to implement measures to control erosion and maintain water quality in the project area in accordance with State and Federal water quality standards; and

#11 g) a Rehabilitation/Revegetation Plan to return the project area to an acceptable environmental condition following termination of the project.

#12 2. The District Engineer shall prepare a comprehensive 404(b)(1) evaluation and coordinate preparation of the document with resource agencies for use in development of the Mitigation Plan.

#13 3. The sediment control dams shall be designed and maintained to treat the water inflow or runoff from disturbed areas from a 10-year, 24-hour precipitation event. Detention time within the pond shall be a minimum of 10-hours until the permittee can demonstrate that water quality standards for suspended sediment can be complied with with lesser detention time.

#14 4. Sediment control dams shall be designed with combination principal and emergency spillways to safely discharge the runoff from a 25-year, 24-hour precipitation event.

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#15 5. The permittee shall cleanup bark and other debris at the log transfer facility periodically and at completion of logging.

#16 6. The permittee shall locate the log rafting area in at least -40 feet mean lower low water.

#17 7. No blasting shall be done at the marine terminal from May through July.

#18 8. A controlled blasting program shall be developed and adhered to during construction.

#19 9. No development of a well field shall occur in the Wilson River drainage.

#20 10. The proposed bridge across the Blossom River, and the proposed road from the Blossom River bridge to the Wilson River well field, shall not be authorized.

#21 11. No water from the Blossom or Wilson Rivers shall be discharged into Tunnel Creek.

#22 12. The storage reservoir on Tunnel Creek shall be designed large enough to minimize the pumping of water from other sources.

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#23 13. The storage reservoir on Tunnel Creek shall be designed with a combination principal and emergency spillway to safely discharge the runoff from a 25-year, 24-hour precipitation event.

#24 14. The storage reservoir on Tunnel Creek shall be designed to maintain instream flows of 90-cfs from July 1 through November 30, 15-cfs from December 1 through March 31 and 30-cfs from April 1 through June 30.

#25 15. Only pumps that are screened to prevent impingement or entrainment of juvenile salmonids shall be used to divert water from the Blossom River.

#26 16. The permittee shall not use a weir or other modification of the Blossom River channel to minimize salt water intrusion into the scour hole of the Blossom River.

#27 17. The middle basin of Boca de Quadra Fjord shall be used for disposal of mill tailings.

If you propose to omit or modify one or more of the Service's requested conditions, please advise us in accordance with "local procedures" agreed to by our offices.

We recognize that you must consider other aspects of the public interest, including cumulative impacts, in meeting your responsibilities under provisions of Section 404 of the Clean Water Act and/or Section 10 of the River and Harbor Act. As a consequence of full public interest review, you may determine that it is necessary to deny this permit or require special conditions.

Sincerely,

Nevin D. Holmberg

Nevin D. Holmberg
Field Supervisor

cc: Regional Office, Ecological Services, Anchorage
Regional Environmental Officer, Department of the Interior, Anchorage
Permits and License, Washington, D.C.
Environmental Coordination, Washington, D.C.
DNR, EPA, ADEC, DGC, NMFS, Juneau
ADFG, Douglas

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 1668
Juneau, Alaska 99802

C2

June 18, 1987

Mr. Don Kohler
Chief, Permit Processing Section
U.S. Army Corps of Engineers
Alaska District, Regulatory Branch
P.O. Box 898
Anchorage, Alaska 99506-0898

Attn: Gene Augustine

RE: Smeaton Bay 5
2-840015

Dear Mr. Kohler:

Reference is made to the subject Public Notice dated May 1, 1987, regarding an application by United States Borax and Chemical Corporation on behalf of the Pacific Coast Molybdenum Company to construct a marine terminal, anchor a floating camp, place mooring buoys, construct an open pile wharf, widen the existing access road, construct new roads, construct a water well field in the Wilson River, place a water supply pipeline from the well field to a 52 foot high dam on Tunnel Creek, and construct a tailings outfall and associated facilities in Wilson Arm of Smeaton Bay.

The National Marine Fisheries Service (NMFS) has reviewed the subject public notice and associated Revised Draft Environmental Impact Statement (RDEIS) prepared by the USDA Forest Service, Environmental Protection Agency, and Department of Army. This is a necessarily complex and controversial project with potential for major impacts to marine, anadromous, and estuarine resources for which we are responsible. The following are our comments and recommendations.

Marine Terminal: Construction and modification of the marine terminal will require conversion of approximately 10 acres of inter- and subtidal habitat into uplands through placement of fill. This shoreline is used by outmigrating salmonids in the early spring. Excessive turbidity and recently disrupted bottom habitat could combine to reduce the availability of food organisms which the juvenile salmon rely on during estuarine outmigration. The marine terminal includes a subtidal area of approximately .5 acre, stabilized with fill, upon which to ground construction barges during initial plant construction and during expansion some years later. Minimal use of this pad may best promote recolonization by benthic organisms and algae. To minimize adverse impacts to salmon, we recommend the following special conditions be placed on the Department of Army permit.

#1 1. No in-water construction during the period April 1 through May 31.

#2 2. After an initial use period of three years, retain, without use or maintenance, the 280'x80' subtidal pad.

#3 Water Well Field: We recommend the request for construction of a Wilson River well field be denied. The Wilson River provides habitat for major runs of pink, chum, coho, and Chinook salmon. Withdrawal of water via the well field could have detrimental effects on the continued production of salmonids. An alternative source of supplementary water, the confluence pool on the Blossom River, is presented in the RDEIS and has been indicated as acceptable to the Applicant. A modified Public Notice should be circulated detailing any work within the Blossom River.

#4 Access Roads: We recommend denial of the proposed access road into the Wilson River and the associated bridges over the Blossom and Wilson Rivers. In absence of the Wilson River well field, the associated road and bridges will be unnecessary.

#5 Water Supply Dam: The mechanisms to provide low flow drainage into Tunnel Creek are not depicted on drawing 25. We are unable to determine the point of entry for the minimum flow stream releases. During periods of no reservoir replenishment will it be possible to drain the reservoir below the normal minimum elevation of 524 feet? Will the water reenter Tunnel Creek at the base of the dam into the existing streambed or at the base of the spillway discharge channel? This information is important because it will be necessary to release minimum flows into Tunnel Creek for protection and continued production of the salmon runs. Further, since mixing Blossom River water with Tunnel Creek discharge could attract Blossom, and perhaps Wilson River spawning stocks into Tunnel Creek, it will be necessary to avoid discharging Blossom River water through Tunnel Creek during the spawning period. We recommend these concerns be addressed by placing the following special conditions on the Department of Army permit:

#6 3. No discharge, through Tunnel Creek, of water obtained from the Blossom River during the period July 1 through September 30.

#7 4. Maintain the following minimum flows in Tunnel Creek:

July 1 through November 30	(for spawning)	90 cfs
December 1 through March 30	(for incubation)	15 cfs
April 1 through June 30	(for rearing)	30 cfs.

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Acknowledged JUN 23 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

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Tailings Outfall and Associated Facilities: The NMFS remains opposed to discharge of mine tailings into Smeaton Bay. We recommend the request for tailings outfall and associated facilities be modified to reflect discharge via tunnel to the Middle Basin of Boca de Quadra (See attached letter). A modified Public Notice should be circulated detailing the tailings outfall and associated facilities in the Middle Basin of Boca de Quadra. #8

Other Facilities:

Sediment Control Dams: We have no objection to the sediment control dams as proposed. If sediment builds up in the reservoirs, threatening overflow into the stream systems, the permitee should be required to remove the sediment to an approved upland location. #9

Mine Personnel Housing: No objection

Mine Service Facility: No objection

Log Transfer Facility: We have no objection to use of the existing wharf facility for short-term log transfer by the method of floating log bundles off skid logs at high tide.

Our review and comment on this permit application do not constitute the full public interest review or cumulative impacts assessment required of the Corps of Engineers. We are, however, willing to assist you with those living marine resource issues identified during the public interest review process. Should you determine that issuance of this permit without the above recommended special conditions and major modifications is in the public interest, we may seek resolution of the matter through the formal elevation process described in the Memorandum of Agreement between Departments of Army and Commerce. Accordingly, we should be notified of your decision in this matter.

Thank you for the opportunity to comment.

Sincerely,

Robert W. McVey

Robert W. McVey
Director, Alaska Region

C2

NMFS contact person: Tamra Faris

cc: ADFG, Douglas, Ketchikan
ADEC, Juneau
ADNR, Juneau
FWS, Juneau, Anchorage, Ketchikan
Applicant, Ketchikan, San Francisco
AK Div. of Governmental Coordination, Juneau
EPA, Anchorage, Juneau, Seattle
USDA Forest Service, Ketchikan

C3

JOHN R. SWANSON
P. O. Box 5554
Minneapolis, Minn. 55406

June 11, 1987.

Corps of Engineers ~ Alaska District
Department of the Army
P.O. Box 898
Anchorage, Alaska 99506.

Attn: NPACC-R (c)

Please accept my following Comments as to the
Quartz Hill Molybdenum Project Mine Development ~ Tongass National Forest

I wish to advise that I oppose such Quartz Hill Mine Project as such development will decimate this area's soil, water, air, wildlife, fish, botanic and roadless resources. Thus, destroying this Quartz Hill non-wilderness area.

And as this area will best serve Man, and all life, as a permanent protected Wilderness I urge that this entire Quartz Hill non-wilderness area be dedicated as Wilderness and added to the Misty Fiords Wilderness, with this enlarged wilderness to total 2,295,000 acres.

And to add valuable areas that are now contiguous to this wilderness so as to fashion the Misty Fiords Wilderness - 3,185,000 acres.

And due to my opposition to this entire Mine Project I, of course, remain opposed to the log transfer facility and authorization for the discharge of mine run landfill and mine tailings.

For when we save our natural lands and waters, we save America!

Sincerely,

John R. Swanson

Acknowledged

RECEIVED
JUN 17 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Q-253

C5

June 22, 1987

Col. Wilbur Gregory
District Engineer
Corps of Engineers
Box 898
Anchorage, AK 99506-0898

Dear Col. Gregory:

I am writing to express my strong opposition to the U.S. Borax proposal to dump mine tailings in Wilson Arm. An objective analysis of benefits and impacts should certainly show that any advantages gained by Borax will be more than offset by the loss of fishery resources by the people of Alaska. I am convinced that the Forest Service is wrong, and EPA is correct in this dispute.

The Wilson, Blossom and Keta Rivers desrve more protection than the Forest Service has been willing to provide. I request that water withdrawals from these rivers, whether by well field or by any other means, be severely limited or eliminated from the mine plan.

The U.S. Borax project has generally received less scrutiny than warrented. I am not convinced that allowing it to proceed under the unenthusiastic oversight of the Forest Service is in the best interest of our state or nation. The cost of doing business in 1987 should include the cost of protecting irreplacable resources. Until there is more evidence that the Forest Service and Borax agree, I am opposed to the project.

Sincerely,

William G. Britt, Jr.

William G. Britt, Jr.
2418 Oak Drive
Anchorage, AK 99508

RECEIVED
JUN 24 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Acknowledged

C8 GV

071-0 YD-2-840015
Smeaton Bay 5

P. O. Box 71
Petersburg, Alaska 99833
June 22, 1987

Acknowledged

Acknowledged
RECEIVED
JUN 30 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Col. Wilbur Gregory
District Engineer
Corps of Engineers
P. O. Box 898
Anchorage, Alaska 99506-0898

Dear Col. Gregory:

As I have done many times, I again express my opposition to allowing Rio-Tinto Inc. (Borax) to discharge tailings and place ita main developments in the Wilson Arm of Smeaton Bay.

To allow a foreign owned company to come in and exploit a non-renewable resource at the expense of a major domestic fishery is unconsionable.

The project description is of an environmental horror. The permit application is for the destruction of one of Southeast Alaska's major productive fisheries. #1

I recall that "Borax" was once quite ready to accept a road route up the Keta in Boca de Quadra. They started building the road before having a permit. I saw the beginning of this shortly after it was abandoned.

I was also informed by a member of the IDT that the Alaska District, Corps of Engineers some years ago granted a permit for developments in Boca de Quadra but was over-ruled and the permit issued for Smeaton Bay! It appears decisions are being made on political rather than environmental grounds. #2

My comments to the Ketchikan Area, Forest Service are enclosed. I list the aspects of this project to which I most object. I urge that this permit application be denied.

Sincerely yours,

Dixie M. Baade

Dixie M. Baade

cc Forest Service
EPA
Governor Cowper

33330

Q-254

C9 GV

U.S.Army Corps of Engineers
Atten. N P A C O-R (C)
P.O.Box 898
Anchorage Ak. 99506-0898

P O Box
Pt. Baker, Alaska

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Kim Betzina

Other comments,

Point Baker, AK 99927

Acknowledged

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JUN 25 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Jos. Sebastian C10

P O Box 129
Pt. Baker, Alaska 99927

U.S.Army Corps of Engineers
Atten. N P A C O-R (C)
P.O.Box 898
Anchorage Ak. 99506-0898

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Joseph Sebastian

Other comments,

Fish First!

Acknowledged
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Alaska District, Corps of Engineers

Q-255

WARREN F POWERS C11

P O Box 50
Pt. Baker, Alaska

U.S.Army Corps of Engineers
Atten. N P A C O-R (C)
P.O.Box 898
Anchorage Ak. 99506-0898

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5, U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this oppertunity to respond.

Sincerely,

Warren F Powers

Acknowledged
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REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Other comments,

It seems that there is always a choice arising between large business that benefits a few and the small person that just wants to continue living with the small people losing out.

When a large business gets a foothold in something it always follows that they start forcing other things across that were never mentioned before and I for one am tired of this

Carol Dejka
P O Box 46
Pt. Baker, Alaska 99927

C12

U.S.Army Corps of Engineers
Atten. N P A C O-R (C)
P.O.Box 898
Anchorage Ak. 99506-0898

May 1987

Dear Sirs,

In reference to # 071-OYD-2-840015, waterway # Smeaton Bay 5,

U S Borax Molybdenum Mine.

The Wilson and Blossem rivers are important salmon streams and should be left in thier natural undisturbed state. U S Borax should have to use Boca De Quadra as originally planned, money or no money. The existing salmon stocks in Wilson and and Blossem rivers are also importent and as living, existing ecosystms and deserve first consideration. U S Borax should have to follow the best enviromental choice and that choice is Boca De Quadra.

Thankyou for this opportunity to respond.

Sincerely,
Carol Dejka

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Alaska District, Corps of Engineers

Q-256

Other comments,

Fishing is a solid economic base of S. E. Alaska. Almost every fishing is now limited by law so that those who fish must practice conservation, so that tomorro there are fish to catch so that tomorro there are fish to eat.

All other activities in the economic base that attempt to interfere for any reason with fish stocks, which for salmon include their spawning streams, are in fact threatening what limited livelihood [illegible] ... [illegible]

U.S. Department of Transportation
United States Coast Guard

Commander
Seventeenth Coast Guard District

P O Box 3-5000
Juneau, AK 99802
Staff Symbol: (oan)
Phone (907) 586-7368

C16

16000
22 MAY 87

Department of the Army
Alaska District, Corps of Engineers
Attn: Regulatory Branch (1145b)
P. O. Box 898
Anchorage, AK 99506-0898

Gentlemen:

The Commander, Seventeenth Coast Guard District, has no comments on the following Public Notices:

~~4-840015-Rev~~ Smeaton Bay 5
M860154
SPN87-1
2-870144
4-870186
4-870216 through 4-870223
1-870231

Sincerely,

J. S. Merrill

J. S. MERRILL
Commander, U. S. Coast Guard
Chief, Aids to Navigation Branch
Seventeenth Coast Guard District
By direction of the District Commander

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Alaska District, Corps of Engineers

C17

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS AND OUTDOOR RECREATION

STEVE COWPER, GOVERNOR

3601 C STREET
ANCHORAGE, ALASKA 99503
PHONE: (907) 561-2020

MAILING ADDRESS
PO BOX 107001
ANCHORAGE, ALASKA 99510-7001

May 15, 1987

Re: 1130-2-1
3130-2R COE

Subject: COE 2-840015 Smeaton Bay 5

Gene V. Augustine
Corps of Engineers
P.O. Box 898
Anchorage, Alaska 99506-0898

Dear Mr. Augustine:

#1

There are two Alaska Heritage Resource Survey (AHRS) listings within the subject project area. While neither site has been determined eligible for listing on the National Register of Historic Places, effort should be made to avoid disturbance of them. KET-203, is an historic cabin ruins site located at the east side of Wilson Arm on a small peninsula about 600 meters south of the mouth of Wilson River (within NW, SE, SW, Sec.1, T75S, R97E, CRM). If this site cannot be avoided, this office should be contacted to begin 36 CFR 800, Section 106 mitigation processing.

#2

KET-038 is a reported burial box site about which little is known. The only information we have for it is that it was noted in 1793 by Captain George Vancouver. The data he gave for it's location was very vague. For AHRS inventory purposes, it's location has been tentatively placed at the east side of Wilson Arm near it's head in Sec. 13, T75S, R97E, CRM. Because of the date of this site's report and the vagueness of it's location, little can be said regarding it's protection. If it is encountered, it is to be protected under our standard project clearance stipulation which is given for all of the subject project area except the KET-203 site locality. This stipulation reads: should cultural or paleontological resources be discovered as a result of the proposed activity, we request that work which would disturb such resources be stopped and the State Historic Preservation Office be contacted immediately at 762-4108.

Sincerely,

Neil C. Johannsen
Director

By: Judith E. Bittner
State Historic Preservation Officer

GD:tlj

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MAY 19 1987

REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

C18

JUNE 5, 1986

DEAR COLONEL WILBUR GREGORY:

I AM SURE THAT YOU ARE AWARE THAT YOUR SUPPORT FOR THE QUARTZ HILL PROJECT AND FOR SELECTION OF THE ECONOMICALLY FAVORED TAILINGS DISPOSAL SITE, NAMELY WILSON ARM/SMEATON BAY, COULD HELP BRING THOUSANDS OF JOBS TO KETCHIKAN AND THE STATE OF ALASKA. WE NEED ALL THE JOBS POSSIBLE AS SO MANY HAVE BEEN SENT OVERSEAS. ANOTHER BENEFIT TO OUR COUNTRY THE EXPORT OF MOLYBDENUM WOULD CONTRITE TO OUR NATIONAL BALANCE OF PAYMENT.

SO I SAY THE QUARTZ HILL PROJECT IS GOOD FOR SO MANY INDIVIDUALS AND SO MANY GOVERNMENTS. SO MAY I COUNT ON YOUR SUPPORT OF THE QUARTZ HILL PROJECT.

SINCERLY AND THANKS

Harwell J. Sleet

Harwell J. Sleet
7463 E. Covey Drive
Tucson, AZ 85715
(602) 577-1218

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REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

c19

Alaska State Legislature
House of Representatives

P.O. BOX 783
GIRDWOOD, ALASKA 99587
(907) 783-2905

WHILE IN JUNEAU
POUCH V
JUNEAU, ALASKA 99811
(907) 465-2693/2719

REPRESENTATIVE
JIM ZAWACKI
DISTRICT 7

MEMBER
COMMUNITY & REGIONAL AFFAIRS COMMITTEE
LEGISLATIVE BUDGET & AUDIT COMMITTEE
FINANCE SUBCOMMITTEE

May 9, 1987

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REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Colonel Wilbur Gregory
District Engineer
US. Army Corps of Engineers
P.O. Box 898
Anchorage, AK 98506-0898

Dear Colonel Gregory:

The proposed Quartz Hill Molybdenum Project would, in my view, provide three areas of important economic benefit. It would, of course, help improve the U.S. balance of payments, presently in a bad imbalance. Second, it would provide short-term construction phase and long-term operations phase jobs for Alaskans, which are urgently needed just now. Third, it would be an important step in the industrial diversification Alaska sorely needs for its own future stability in that it would reduce Alaska's single-industry dependence on petroleum.

I am well satisfied that environmental concerns have been well met, whether the Wilson Arm disposal area or the very conservative Boca de Quadra option is selected.

I sincerely hope that the long-standing partnership between the Corps and Alaska will be among your considerations as you deliberate the necessary approvals.

Sincerely,

Jim

Jim Zawacki
Representative

JZ:p-m

cc:U.S. Borax

Q-258

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c23

University of Idaho
College of Mines
and Earth Resources
Department of Metallurgical
and Mining Engineering
Moscow Idaho 83843
(208) 885-6376

May 26, 1987

Colonel Wilbur Gregory, District Engineer
U.S. Army Corps of Engineers
PO Box 898
Anchorage, AK 99506-0898

Dear Colonel Gregory:

I am writing to you about the Quartz Hill Project of the U.S. Borax Company.

I've been waiting with much anticipation to see the project get underway. I have followed the special efforts made by the company to preserve the area in its best natural beauty, while still taking advantage of the uniqueness of the deposit to help the economy of Alaska and our country.

We cannot rely upon a service and information economy solely to compete with the rest of the world. This has been proposed by many people, but with little substance other than belief to back it. We are now seeing the high technology as an additional take over by the rest of the world and even to the extent of telephone conversations over the 800 numbers going offshore.

I believe the company has done a superb job of making plans for protection of the environment such that the degradation will be no greater than nature itself would impose but obviously over a much longer period.

Alaska is particularly subject to income from taxes or natural resources. Without both in balance, the progress you have made will not continue or even be secure. The income, jobs, social stability and the economy of the area will be greatly enhanced by this project for a very long time. I believe it would be short sighted and contrary to the best interests of Alaska, if the project were not to proceed.

Obviously no activity in any area can guarantee absolute environmental purity. Not even nature does this. We have trade-offs we must make between our economy, social well being and the environment. If we are hungry or without work, no matter what our surroundings may be, our immediate and effective environment is unacceptable. If we are not

Acknowledged
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JUN 01

Where Tradition Meets the Future
1889-1989
University of Idaho

C23

willing to utilize the materials nature has provided for us, by setting up proper safeguards and environmental controls and living by them, we then must reconcile that our civilization is to return to a hunting and fishing way of life. This may sound good, but it would not provide us with all of the facilities and progress we have today.

The product Quartz Hill will produce - molybdenum - is used by you regularly in the mechanical equipment, planes, boats and trucks and it is to your benefit to be a part of this in producing the metal. More importantly the tremendous number of dollars that will go into making the mine operate, as well as the annual income, both taxable and trickle down, through purchases and wages will enable the area to prosper. Even your paycheck is partly dependent upon this type of income. Without it we will have little chance of even protecting the forests or any of our environment if we don't have adequate income and industrial structure in our country.

I am anxious that you see the absolute necessity of a viable Quartz Hill project and I would urge you to expedite its preparation and operation in any way that you can.

Sincerely,

J. R Hoskins

J. R. Hoskins
Head, Department of Metallurgical
and Mining Engineering

JH/ec

C29 6V

6-26-87
Box 9395
Ktn, Alaska 9990

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JUN 30 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

Dear Col. Gregory,

This editorial expresses our concerns here in Ketchikan. We need the jobs and the "environmental improvement" for the people of Ketchikan.

Please, help if you can.

The environmental impact has been researched to the "nth" degree. Now let's "get on" with it.

Thanks for any help you might give this project. Many are apathetic who might be affected very much but feel their letters won't help. I'm not. We need this economic boost to our community. Those of us who are retired need this soon -

Thank you very much,
[illegible]

Acknowledged

Editorial

Due soon

In two weeks the comment period ends for the draf environmental impact statement for U.S. Borax's Quartz Hil project. More than 100 comments have been made to the Forest Service office in Ketchikan in the month that comment has been open. All but a half dozen comments have favorec the Forest Service alternative to allow tailings disposal ir Wilson Arm.

The main concern in debate over the impact of the mine operation is tailings disposal in Wilson Arm may affect fisheries. So far, Borax's operation — building an access road and taking out a bulk sample of the ore — has had no effect on fisheries or fishery habitat. There won't be a negative impact on fisheries or fish habitat, according to law. It's all laid out in Section 505 (a) (b) (c) and (d) of the Alaska National Interest Lands Conservation Act of 1980.

Under terms of that section, the Secretary of Agriculture cooperates with the state to assure the mining operation is conducted without damage to fisheries or fish habitat. In the event there is damage, the secretary is required to shut down the operation for seven days, during which time he can go to U.S. District Court for an injunction stopping operations.

That's a strong stand in support of fisheries and it's the law, not just a policy or a promise.

Therefore, Borax should be allowed to go ahead with tailings disposal in Wilson Arm, as the company officials desire. They are required to do the job right or suffer the consequences, which we are sure the state Fish and Game department will cause the secretary to invoke if damage is found. The law says the state retains control over fisheries.

More important immediately is for those who favor the project to send in a letter of support. In the letter, cite a specific effect or reason why the writer believes the project should be allowed to move ahead.

After suffering the collapse of oil prices, Alaskans swore to diversify the state's economy. One way to do that is to develop the hard rock minerals in Alaska. Quartz Hill is a major part of such development and should move along promptly.

C32

US BORAX

June 29, 1987

U.S. Army Corps of Engineers
Alaska District, Regulatory Branch
P.O. Box 898
Anchorage, Alaska 99506

Attention: Mr. Gene V. Augustine

Subject: Ref. No. 071-OYD-2-840015
Public Notice of Application and
404 (b) (1) Evaluation

Dear Mr. Augustine:

On behalf of Pacific Coast Molybdenum Company, U.S. Borax is pleased to respond to the Corps of Engineers' request for comments on the subject documents. The two documents are a part of the Revised Draft Environmental Impact Statement upon which we have commented in separate letters. We have no substantive comments on either the Public Notice or the Evaluation since they reflect our proposed project as modified for a Wilson Arm/Smeaton Bay tailings discharge. Should the Final EIS determination differ from the current application, a revised application for permit may be necessary.

Please do not hesitate to call either Ken Reim, Don Finney or the writer if you have any questions.

Sincerely,

C. A. Hesse
Vice President & Project Manager
Quartz Hill

CAH:ems

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JUN 30 1987
REGULATORY FUNCTIONS BRANCH
Alaska District, Corps of Engineers

C32

cc: Mr. Win Green
U.S. Forest Service
Federal Building
Ketchikan, Alaska 99901

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Attention: Mr. Robert S. Burd, Director
Water Division

Office of Management & Budget
Division of Governmental Coordination
Pouch AM
Juneau, AK 99811

Attention: Mr. Robert Grogan, Director

UNITED STATES BORAX & CHEMICAL CORPORATION • 3075 WILSHIRE BOULEVARD • LOS ANGELES CA 90010-1294 • 213-381-5311
MAIL ADDRESS P.O. BOX 75128 SANFORD STATION LOS ANGELES CA 90075-0128

C33

Acknowledged
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MAY 28 1987
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Alaska District, Corps of Engineers

COL. Wilbur Gregory

District Engineer

I do not want U.S. Borax to build the mine in Misty Fjords. Here are my reasons: 1) It is not a renewable resource and tourism is. What tourist will be interested in looking at a mess in the middle of a wilderness area? 2) Molybdenum, while a useful element, is not used in great proportion in the manufactoring of alloys. The sigifigance of the current low price of molybdenum on the world market is a reflection of suppl and demand. There is not that great of a demand, and there are many molybdenum mines already in existence to supply demand. In fact, mines in British Columbia and Nevada have closed because the supply is greater than the demand, and the price os molybdenum makes mining it ecomically unfeasible. 3) U.S.Borax is so profit minded that it is willing to dump tailings into viable fish-producing areas, another renewable resource, in orde: to make a profit. As already pointed out molybdenum is a marginally econmically feasible element to begin with, so U.S. Borax is forced to finc the cheapest way to mine it. Unfortunately this means polluting the waters in order to make a profit. 4) There is little remaining wilderness in the world, and the value of allowing future generations the chance to experience it by far out weighs U.S. Borax's short term profit goals. 5) Please factor in the fact that the number of letters you get in support of the mine is in direct correlation to the number of propaganda ads placed in the Ketchikan Daily News recently by U.S.Borax, and that a majority of them, no doubt, are parroting U.S. Borax's position to dump the tailings into the pristine waters.

Sincerely, Jed Whittke

Jed Whittke Rt 1 Bx 198 Ketchikan 99901

APPENDIX R

RESPONSES TO COMMENTS

APPENDIX R
RESPONSES TO COMMENTS

CONTENTS

0283K

CONTENTS (cont.)

LIST OF TABLES

LIST OF FIGURES

0283K

INTRODUCTION

The notice of availability of the Revised DEIS was published in May 1987 and the period for public comment extended from that date through (date). During the public comment period, 267 letters and petitions were received. The widespread interest in this project is reflected in the distribution of respondent locations: 73 from the Ketchikan-Gateway Borough, 54 from elsewhere in southeast Alaska, 51 from other parts of Alaska, and 89 from other states and Canada. The varied affiliations of the respondents also reflect the widespread interest: 133 letters were from individuals, 7 from local government agencies, 8 from State government, 6 from Federal government, 7 from conservation or environmental groups, 85 from businesses or business groups, 2 from U.S. Borax, 9 from fishermen and fisheries-related businesses, and 10 from miscellaneous other groups.

The letters received are bound as Appendix Q to this document. As each letter was logged in, it was numbered and the separate issues addressed were also numbered. Thus, each comment is identified by a Letter/Issue number; 148/6 indicates the 6th issue mentioned in Letter No. 148.

All comments have been logged, categorized, and answered, either individually or collectively, in this Appendix. Each comment has been carefully considered and all necessary revisions in response to the comments have been incorporated into the Final EIS. Where comments were the same or similar, they have been addressed collectively. Table R-1 provides the name and affiliation of each commentor, the date of his or her letter, and the subject area(s) addressed in the letter. To assist commentors in locating the responses to their comments, Table R-2 is provided. Table R-2 lists each letter/issue number and notes the Appendix R subsection in which the response is located. A few comments were responded to both by the Forest Service and EPA. In those cases, the locations of both responses are noted in Table R-2. In the text, the Letter/Issue number of the comment(s) being addressed is given in parentheses at the beginning of each response.

Most of the comments on the Revised DEIS were related to various aspects of tailings disposal in either Wilson Arm or Boca de Quadra. The first two major sections (R-1 and R-2) address those comments. Responses to comments on the project's water supply and possible fisheries impacts constitute the next two sections (R-3 and R-4). Socioeconomic concerns also constituted a large number of comments, and they are addressed in the fifth section (R-5).

Comments that didn't occur as frequently, such as those regarding the transmission line, air quality, or water quality not related to tailings disposal, are addressed in the subsequent sections (R-6 through R-8). General comments on other topics follow (R-9) and editorial or minor comments on wording are identified in the final section of Forest Service responses (R-10). Responses of the U.S. Army Corps of Engineers appear in Section R-11, while responses prepared by the Environmental Protection Agency appear in Section R-12.

TABLE R-1
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
1	David J. Moe UNITED FINANCIAL CORP.	4/29/87	X	X											
2	Dan R. Ford	4/29/87	X												
3	Sidney S. Alderman, Jr.	4/30/87	X										X		
4	C. Waco Shelley	4/30/87	X												
5	John J. Cowin	5/1/87	X										X		
6	Earl H. Beistline	5/1/87	X	X									X		
7	Walter W. Shuham SHUHAM & MILNER, P.C.	5/2/87					X						X		
8	James A. Wilson	5/4/87	X	X											
9	Rueben C. Rose	5/5/87	X										X		
10	Ed Craig	5/5/87		X		X									
11	Eugene D. Smith Barbara Smith	5/5/87	X	X											
12	Harold Koehler	5/5/87											X		
13	Ralph M. Bartholomew IRELAND TRANSFER & STORAGE	5/6/87	X	X											
14	Donald R. Melnick R.W. BECK & ASSOC., INC.	5/6/87	X	X											
15	J. Charles Pool POOL ENGINEERING, INC.	5/8/87	X	X		X									
16	Terral F. Wanzer THE LANDING	5/2/87		X											

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
17	Kay Sims THE GILMORE HOTEL	5/2/87	X	X											
18	T.R. Parsons UNIV. OF BRITISH COLUMBIA	5/4/87		X	X						X				
19	Stan A. Oaksmith III Bonnie L. Oaksmith	5/8/87	X	X											
20	Robert Adams MADISON LUMBER & HARDWARE	5/10/87	X	X											
21	Virginia Craig	5/5/87		X		X									
22	Kenneth B. Gorton, Sr. Margit V. Gorton	5/4/87	X	X											
23	George B. Griswold NEW MEXICO TECH	5/7/87	X	X									X		
24	Drue Pearle ALASKA STATE HOUSE OF REPRESENTATIVES	5/10/87	X	X											
25	Pat Hook Les Hook	5/12/87	X	X		X									
26	Robert B. Elliot COASTAL MACHINERY, INC.	5/12/87	X	X											
27	Paul Fischer ALASKA STATE SENATE	5/11/87	X												
28	Norman A. Wilson SNOW CONSULTANT SERVICES	5/12/87		X									X		

8030a

TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
29	John Stevens PORT OF GRAYS HARBOR	5/12/87	X	X											
30	John B. Coghill ALASKA STATE SENATE RESOURCES COMMITTEE	5/12/87	X	X											
31	A.P. Ludwick	5/13/87	X										X		
32	Twyla G. Coughlin SOUTHEAST REGIONAL RESOURCE CENTER	5/13/87	X	X											
33	John Stewart	N.D.	X	X											
34	Leslie Noyes MINERS ADVOCACY COUNCIL	5/11/87	X	X											X
35	A.M. Petrofsky JACOBS ASSOCIATES	5/12/87	X	X											
36	Ralph C. Gregory KETCHIKAN GATEWAY BOROUGH	5/12/87	X												
37	Dick Shultz ALASKA STATE HOUSE OF REPRESENTATIVES	5/13/87	X	X											
38	Ray J. Coleman	5/13/87	X	X											
39	Alvin H. Fleetwood ENSERCH ALASKA SERVICES, INC.	5/14/87													
40	Ross B. Dunfee TRYCK, NYMAN & HAYES	5/14/87		X		X									
41	T.L. Capion	5/14/87	X	X	X							X			
42	J.H. Hallahan	5/14/87		X			X								

8030a

TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
43	C.G. Fader	5/14/87	X	X											
44	John Sims USIBELLI COAL MINE, INC.	5/14/87	X	X											
45	Fred Athorp	5/14/87	X	X	X	X	X								
46	Francis M. Delach	5/15/87		X			X			X		X			
47	Earl L. Fosse FOSSE MECHANICAL, INC.	5/15/87		X											
48	Douglas J. Thompson	5/18/87					X								
49	Jenny Hawley	5/14/87		X											
50	Lloyd F. Hames PORT WEST, INC.	5/14/87		X			X		X						
51	Curtis V. McVee ALASKA MINERS ASSOC., INC.	5/17/87	X	X			X				X				
52	Donald A. Bell ALASKA TIMBER INSURANCE EXCHANGE	5/19/87	X	X				X							
53	Louise Brinck Harrington	5/20/87	X												
54	J.R. Turner	5/18/87		X											
55	Walter J. Diffley	5/18/87	X	X	X										
56	Derek Ellis UNIVERSITY OF VICTORIA	5/13/87	X	X	X							X			X
57	J.P. Bingham GREENS CREEK MINING CO.	5/18/87		X											

8030a

TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
58	R.A. Wickman M.A. HANNA COMPANY	5/19/87	X												
59	Thomas M. Cromwell	5/20/87		X											
60	Jackie E. Stephens	5/20/87		X											X
61	Mary D. Crunican	5/21/87	X	X											
62	Patricia L. Bates	5/21/87	X	X											
63	Peter M. Douglas HART CROWSER	5/21/87								X			X		
64	Virginia Klepser	5/21/87	X	X			X								
65	C.W. Hoffman PERFORMANCE ASSOCIATES, INC.	5/21/87		X								X	X		
66	Gerald L. Moseley	5/21/87											X		
67	Jay E. Coon MOUNTAIN VIEW TRAILER COURT AND SALES	N.D.	X				X								
68	Gordon B. Crary, Jr. E.F. HUTTON	5/18/87	X										X		
69	George B. Kruse ALASKA STATE CHAMBER OF COMMERCE	5/19/87	X	X			X				X				
70	Jed Whittaker	N.D.		X			X					X	X		
71	Joseph E. Usibelli USIBELLI COAL MINE, INC.	5/20/87	X	X			X			X					

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Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
72	Robert C. Crowder Rosemary H. Crowder RIDGEWOOD MOBILE HOME PARK AND SALES	5/21/87											X		X
73	Thomas V. Van Dawark FOSS MARITIME COMPANY	5/21/87	X												
74	William F. Rotecki	5/26/87											X		
75	Ted Ferry CITY OF KETCHIKAN	5/26/87	X	X						X		X			
76	J.R. Hoskins UNIVERSITY OF IDAHO	5/26/87	X										X		
77	J. B. Davis	5/26/87		X											
78	T.P. Gallagher CHEVRON U.S.A., INC.	5/27/87	X												
79	Don Thornlow NATIONAL BANK OF ALASKA	5/29/87		X											
80	E.O. Bracken	5/27/87	X	X			X								
81	Stephen M. Connelly	5/27/87	X	X											
82	Jeffrey J. Cook COOK COMPANY, REALTORS	5/29/87		X											
83	Rose Rybachek LIVENGOOD/TOLOVANA MINING DISTRICT	5/27/87	X	X											
84	C.C. Hawley HRG HAWLEY RESOURCE GROUP	5/28/87		X											

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
85	R.M. Watt WEST COAST STEVEDORING CORP.	N.D.	X	X				X							
86	Randall C. Shaver	5/28/87	X	X											
87	I.L. White-Thomson	5/27/87	X	X											
88	A. Ronald Nerland NERLAND'S HOME FURNISHINGS	5/29/87	X										X		
89	Nancy M. Watt ALASKA CRUISE LECTURES	6/1/87	X									X			
90	Richard Whittaker	6/1/87	X	X											
91	Curtis G. Shattuck	6/1/87	X	X											
92	Tom Finch MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY	5/28/87	X										X		
93	F.O. Eastaugh ROBERTSON, MONAGLE, & EASTAUGH	5/29/87	X	X				X							
94	Allen Vezey LAKLOEY, INC.	5/30/87	X	X											
95	Irene Luon	N.D.		X											
96	John Mulligan ALASKA MINERS ASSOC., JUNEAU BRANCH	6/1/87	X	X											
97	Earl H. Beistline	6/1/87		X											X

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
98	Kenneth C. Eichner TEMSCO HELICOPTERS, INC.	6/1/87	X				X								X
98A	Shelagh Kasinger TEMSCO HELICOPTERS, INC.	6/9/87													X
99	Thomas J. Miklautsch	6/2/87		X									X		
100	Jan Faiks ALASKA STATE SENATE	6/3/87	X												
101	Robert Bates, Jr.	5/29/87	X	X											
102	James F. Clark ROBERTSON, MONAGLE & EASTAUGH	6/3/87	X	X											
103	J. Allan MacKinnon	6/2/87	X	X											
104	T.R. Dunn	6/2/87	X	X									X		
105	Charles J. Kundert	6/2/87	X	X											
106	Charles Sorvisto	6/3/87													
107	Harwell J. Sleet	6/5/87	X	X											
108	Clarence Petty	6/5/87		X			X			X		X			
109	T.C. Quinn CAPITAL OFFICE SUPPLY	6/6/87	X	X											
110	James A. Van Altvorst CITY OF KETCHIKAN	6/6/87	X												
111	Kim J. Betzina Sue C. Betzina F/V BOLD VENTURE	6/14/87		X			X								

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
112	Robert C. Munro	6/9/87		X											
113	J.D. Larimore	6/9/87	X	X											
114	Gary Wilken FAIRBANKS DISTRIBUTORS	6/9/87	X	X											
115	Lloyd Jones ALASKA STATE SENATE	6/10/87	X												
116	Florian Sever	6/3/87		X								X			
117	Chuck Becker ALASKA SUPPORT INDUSTRY ALLIANCE	6/5/87	X	X											
118	Steven R. Punch CHUGIAK-EAGLE RIVER CHAMBER OF COMMERCE	6/5/87	X	X							X	X			
119	Robert W. Loescher SEALASKA CORPORATION	6/5/87	X	X						X					
120	J. Ellsworth Jensen	6/8/87		X			X						X		
121	Arthur N. Wilson, Jr.	6/9/87	X	X											
122	Cliff Kamm	6/10/87		X											
123	Wayne K. Beckwith ANCHORAGE CHAMBER OF COMMERCE	6/10/87	X	X											
124	Roger L. Hames GREATER SITKA CHAMBER OF COMMERCE, INC.	6/4/87	X	X											
125	Frank Seiersen GREATER JUNEAU CHAMBER OF COMMERCE	6/8/87	X	X											

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
126	Warren T. Powers	6/8/87	X	X			X			X		X	X		
127	Angie Newby HOMER CHAMBER OF COMMERCE	6/8/87	X	X											
128	F.J. Nozak	6/6/87	X	X		X									
129	William Thompson	6/12/87										X			
130	James E. Carter, Sr. KENAI CHAMBER OF COMMERCE	6/12/87	X	X											
131	D.J. McDonald Mary H. McDonald	6/14/87	X												
132	Lonnie L. Haughton	N.D.					X								
133	David G. Austin	6/5/87	X	X											
134	Cathy M. Clark SEAWARD CHAMBER OF COMMERCE	6/12/87	X	X											
135	Cliff R. Taro SOUTHEAST STEVEDORING CORP.	6/15/87	X	X				X							
136	John R. Swanson	6/11/87							X			X			
137	David Wieler	6/11/87		X	X		X						X		
138	Sharon R. Wilson	6/17/87	X	X											
139	Bob Rowland Pat Rowland	6/17/87	X										X		
140	Jim Green	6/18/87	X	X		X	X								

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
141	Curtis L. Terrall	6/18/87		X			X								
142	Daniel P. Walters	6/17/87		X											
143	Katya Kirsch	N.D.		X		X	X								
144	Kurt Kondzela	6/17/87		X			X								
145	Steven C. Borell	6/15/87	X	X		X									
146	J.R. Hoskins UNIVERSITY OF IDAHO	6/17/87	X	X											
147	Steve W. Denton	6/18/87	X	X											
148	Rodney V. Harmsworth HARMSWORTH ASSOCIATES	6/18/87		X	X		X								X
149	Donald F. Pierce COASTAL MACHINERY INC.	6/18/87	X												
150	Charles T. Angelis	N.D.	X	X											
151	Thomas Wilhelm	6/16/87		X			X				X		X		
152	John J. Meersman BECHTEL ENVIRONMENTAL, INC.	6/19/87		X	X	X									
153	Joyce Stevens	6/20/87		X								X			
154	Robert E. Dawson Alice M. Dawson	6/20/87	X	X			X								
155A	Rochelle Rollenhagen	5/87					X								
155B	Sue Betzina	5/87					X								
155C	Joan Kautzer	5/87					X								
155D	Joseph Sebastian	5/87					X								

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Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
155E	Herbert Oyler	5/87					X								
155F	Mike Mortell	5/87					X								
155G	Sonja L. Paine	5/87					X								
156	David L. Nebert	6/22/87			X									X	X
157	F.M. Smith	N.D.	X	X			X		X			X			
158	Larry Herrman	N.D.	X	X			X								
159	Frank Norris	6/21/87	X	X		X	X					X			
160	Walter Pelech Dorothy Pelech	6/22/87										X			
161	Mark J. Kirchhoff CITY OF PORT ALEXANDER	6/22/87		X			X								
162	Jill A. Armin	6/22/87	X	X			X					X			
163	William G. Britt, Jr.	6/22/87		X		X	X								
164	R.M. Massenburg	6/22/87	X										X		
165	Mary Margaret Snyder GREATER WASILLA CHAMBER OF COMMERCE	6/8/87	X												
166	E.E. Smith	6/20/87	X				X								
167	Robert Markeloff	6/22/87		X			X					X			
168	Ginney DeVries	6/22/87	X	X		X	X					X			
169	Edna L. Hatch James Hatch	6/22/87	X	X		X									
170	Jeff Sauer	6/22/87	X	X			X					X			

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
171	Dixie M. Baade	6/22/87	X	X		X	X					X			
172	Earl E. Krygier ALASKA TROLLERS ASSOC.	6/23/87		X			X								
173	Daniel Henry	N.D.		X			X					X			
174	Gene H. Skovbo	6/24/87		X		X	X								
175	Gary Freitag SOUTHERN SOUTHEAST REGIONAL AQUACULTURE ASSOC., INC.	6/24/87		X	X	X	X						X		
176	John Peckham SOUTHEAST ALASKA SEINERS	N.D.	X	X	X	X	X			X		X			
177	Ruth M. Zencey	6/87		X											
178	Madeleine S. France	6/22/87		X			X								
179	James L. Cloud	6/23/87	X	X		X		X							
180	Ronald Hocking	6/22/87		X											
181	Robert W. McVey NATIONAL MARINE FISHERIES SERVICE	6/18/87		X	X	X	X			X	X			X	
182	Jerry Dzugan ALASKA WYLDEWIND CHARTERS	6/23/87		X			X								
183	Vera Alexander UNIVERSITY OF ALASKA, FAIRBANKS	6/23/87											X		

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
184	John	6/23/87											X		
185	Kenneth V. Morton	6/23/87		X			X					X			
186	Randall H. Wirst	6/24/87	X	X			X								
187A	Ronald Arntzen	6/25/87	X												
187B	Inga Chapin	6/25/87	X												
187C	Don Jeffords	6/25/87	X												
187D	Robert Johnson	6/25/87	X												
187E		6/25/87	X												
187F	J.R. Meskinren	6/25/87	X												
187G	Doug Wallin	6/25/87	X												
187H	R. Redlinger	6/25/87	X												
187I	Bryan Gardiner	6/25/87	X												
187J	Edward R. Ness, Jr.	6/25/87	X												
187K	Mike Chowka	6/25/87	X												
187L	A. Richland	6/25/87	X												
187M	Bob Swertsin	6/25/87	X												
188	Vern R. Starks	6/15/87	X	X								X			
189	Richard Spotts	6/22/87		X			X						X		
190	Ralph A. Wells	6/22/87		X			X								

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
191	Ron Guenther SIERRA CLUB - REDWOOD CHAPTER	6/23/87		X			X								
192	Dianna M. Brown	6/23/87		X			X								
193	Larkette Lein	6/23/87		X			X								
194	R.C. Johnstone, Jr. BECHTEL, INC.	6/23/87		X		X	X								
195	J.G. Hansen	6/23/87		X									X		
196	George Cooper	6/24/87		X											
197	Becky L. Gay RESOURCE DEVELOPMENT COUNCIL	6/24/87	X	X	X	X	X	X				X			
198	Sondra Stanway	6/24/87		X			X								
199	Dennis Haller	6/24/87		X											
200	Olga Rosche	6/24/87		X			X								
201	Paul Berry	6/24/87	X				X					X	X		
202	Chris S. Tomich Kent	6/25/87		X			X								
203	Diane B. Hankins	6/25/87		X								X	X		
204	Dan Morington	6/25/87		X									X		
205	John C. Menzie KETCHIKAN COMMUNITY COLLEGE	6/25/87	X	X								X			

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
206	Bart Koehler SOUTHEAST ALASKA CONSERVATION COUNCIL	6/26/87	X	X		X	X					X			
207	Ruth Stump	6/26/87	X												
208	James S. Burling PACIFIC LEGAL FOUNDATION	6/26/87	X	X			X								
209	Audrey Gilbert	6/26/87	X	X			X								
210	Grace S. Moore	6/26/87	X	X			X								
211	Anthony Kennedy	6/26/87	X												
212	Michael Sallee	6/27/87	X									X	X		
213	Roger Sullivan ALASKA LOGGERS ASSOC., INC.	6/29/87	X	X											
214	Lesley J. Kempsell	6/25/87		X		X									
215A	Rondo Ludwig	6/25/87	X	X											
215B	Thornson A. Rentz	6/25/87	X	X											
215C	Mike ________	6/25/87	X	X											
215D	Peter W. Amundson	6/25/87	X	X											
215E	Robert G. Young	6/25/87	X	X											
215F	Marian R. ________	6/25/87	X	X											
216	Paul J. Wingren WINGREN ENTERPRISES	6/22/87	X	X			X								

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TABLE R-1 (Continued)
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Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
217	Kim Conley Michael Conley	6/25/87	X	X											
218	Rich Chamberlin	6/26/87		X			X								
219	Eileen Faust William Faust	6/26/87		X											
220	Sylver Carpenter	6/26/87	X												
221	Antoinett Kustka	N.D.		X	X		X					X			
222	Sharon L. Osowski	N.D.		X			X					X			
223	Scott Luchessa	6/27/87		X	X		X								
224	George L. Beck Mary L. Beck	6/28/87	X										X		
225	Craig B. Burger CAPE FOX CORPORATION	6/29/87	X	X											
226	Candin I. Coombs	6/29/87		X	X	X	X								
227	Jim Raabe GREATER KETCHIKAN CHAMBER OF COMMERCE	6/29/87	X	X		X	X			X	X				
228	Denny Ann Terry	N.D.	X												
229	Don Young ALASKA STATE HOUSE OF REPRESENTATIVES	6/22/87	X	X			X								

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
230	C.A. Hesse U.S. BORAX	6/26/87	X	X		X	X			X	X				
231	Jim Watson Bette Watson	6/29/87	X	X			X						X		
232	Kathryn Troll KETCHIKAN GATEWAY BOROUGH	6/29/87	X							X					
233	Terry R. Wills	N.D.	X	X			X								
234	J. Neerhout, Jr. BECHTEL GROUP, INC.	6/23/87	X	X											
235	Philip Stage	6/23/87	X	X		X	X					X			
236	Lawrence A. Papp	6/25/87		X											
237	Mary M. Dillon	6/26/87		X	X		X								
238	Jerry L. Morrisey	N.D.		X			X						X		
239	Harold L. Dittmer	6/26/87	X	X									X		
240	Marlene Clarke JOY'S FINE GIFTS	6/29/87		X		X	X						X		
241	James E. Swink	6/27/87	X	X											
242	Helen Finney	6/26/87	X	X											
243	Kim M. Wold ALASKA APPRAISAL ASSOCIATES	6/29/87	X	X											
244	C.A. Hesse U.S. BORAX	6/29/87	X	X	X	X	X		X	X		X	X	X	X

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Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
245	Deirdre Holum	6/30/87		X			X								
246	Lew M. Williams, Jr. KETCHIKAN DAILY NEWS	N.D.	X	X			X						X		
247	Sy Painter	6/30/87		X		X	X								
248	Jill Dobrydnia Randy Dobrydnia	N.D.	X	X			X					X	X		
249	Ray Bloom PEI CONSULTANTS, INC.	6/30/87	X	X		X	X					X			
250	Peter J. Slaby	6/27/87		X									X		
251	Dick Wilson	6/29/87										X			
252	Philip S. Barnett, Alan Birnbaum SIERRA CLUB LDF, INC.	6/30/87		X	X	X	X	X	X	X		X	X		
253	Michael B. Salazar KETCHIKAN AIR SERVICE, INC.	6/30/87	X	X		X						X			
254	Stan Leaphart CITIZENS' ADVISORY COMMISSION ON FEDERAL AREAS	6/30/87	X	X		X	X			X	X	X			
255	James L. Cronin	6/29/87	X	X	X		X					X			
256	Dean Lemon	6/30/87	X	X											

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
257	Earl Beistline ALASKA MINERALS COMMISSION	7/1/87	X	X							X				
258	Andrew P. Butler	6/24/87	X	X	X		X			X			X		
259	David L. Schneider	6/29/87		X	X		X								
260	J. David Benson	6/30/87	X	X									X		
261	Robie G. Russell U.S. EPA REGION X	7/6/87	X	X	X	X	X	X	X	X			X		X
262	Robert L. Grogan STATE OF ALASKA OFFICE OF MANAGEMENT AND BUDGET	7/2/87	X	X	X	X	X	X	X	X	X				X
263	Mary V. Hausler	6/25/87	X	X		X	X					X	X		
264	Alec W. Brindle	7/6/87		X			X						X		
265	Ted Stevens UNITED STATES SENATE	6/30/87	X	X								X			
266	Bruce Blanchard USDOI, OFFICE OF ENVIRONMENTAL PROJECT REIVEW	7/28/87	X	X	X	X	X	X		X			X		
267	Peter Dragovich KETCHIKAN GATEWAY BOROUGH (internal memo)	5/26/87													
C1	Nevin D. Holmberg U.S. DEPT. OF THE INTERIOR, FISH AND WILDLIFE SERVICE	6/26/87					X			X		X			

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
C2	Robert W. McVey U.S. DEPT. OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE	6/18/87		X			X								
C3	John R. Swanson	6/11/87		X											
C5	William G. Britt, Jr.	6/22/87		X											
C8	Dixie M. Saade	6/22/87		X			X								
C9	Kim Betzina	5/87		X			X								
C10	Joseph Sebastian	5/87		X			X								
C11	Warren F. Powers	5/87		X			X								
C12	Carol Dejka	5/87		X			X								
C16	J.S. Merrill U.S. COAST GUARD	5/22/87											X		
C17	Judith E. Bittner STATE OF ALASKA DEPT. OF NATURAL RESOURCES DIVISION OF PARKS AND OUTDOOR RECREATION	5/15/87								X					
C18	Harwell J. Sleet	6/5/87	X												
C19	Jim Zawacki ALASKA STATE LEGISLATURE, HOUSE OF REPRESENTATIVES	5/9/87	X												
C23	J.R. Hoskins UNIVERSITY OF IDAHO	5/26/87											X		

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TABLE R-1 (Continued)
REVISED DEIS COMMENT LOG

Letter No.	Author/ Firm or Agency	Date of Letter	Socioeconomics	Tailings Disposal	Tailings Toxicity	Water Supply	Fisheries Impacts	SE Alaska Intertie	Air Quality	Mitigation Plans	Monitoring Response	Wilderness Impacts	Other Comments	Editorial Comments	Provides Additional Information
C29	Grace S. Moore	6/28/87	X												
C32	C.A. Hesse U.S. BORAX	6/29/87											X		
C33	Jed Whittaker	6/28/87		X											

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TABLE R-2

LOCATION OF RESPONSES TO COMMENTS

Letter/ Issue	Response Location USFS	EPA	Corps	Letter/ Issue	Response Location USFS	EPA	Corps
2/1		R-12.5		156/3	R-1.1		
4/1		R-12.5			R-2.1		
4/2		R-12.5		156/4	R-1.1		
35/1		R-12.5		156/5	R-1.1		
35/2	R-1.4			156/6	R-1.1		
39/1		R-12.5		156/7	R-1.1		
41/1		R-12.5		156/8	R-1.1		
56/1	R-1.5			156/9	R-1.1		
57/1		R-12.5		156/10	R-1.2		
71/1		R-12.5		156/11	R-1.2		
90/1	R-1.5			156/12	R-1.2		
93/1	R-1.4			156/13	R-1.3		
93/2	R-6.0			156/14		R-12.4	
105/1		R-12.5		156/15		R-12.4	
108/1	R-1.5			156/16		R-12.4	
119/1		R-12.5		156/17		R-12.4	
137/1	R-1.5			164/1	R-9.0		
137/2	R-9.0			171/1	R-1.5		
148/1	R-2.1	R-12.4		171/2	R-1.4		
148/2	R-2.2	R-12.3		173/1	R-1.5		
148/3	R-2.1	R-12.4		174/1	R-1.5		
148/4	R-2.4	R-12.4		174/2	R-5.4		
148/5	R-2.2	R-12.5		176/1	R-4.2		
148/6	R-2.2	R-12.4		176/2	R-4.2		
148/7	R-2.2	R-12.3		176/3	R-3.3		
148/8	R-2.2	R-12.4			R-4.2		
148/9	R-2.1	R-12.3		176/4	R-1.4		
148/10	R-2.1			176/5	R-5.1		
150/1		R-12.5		176/6	R-3.3		
150/2	R-5.1			176/7	R-4.3		
151/1		R-12.5		181/1	R-2.4	R-12.3	
152/1		R-12.1		181/2	R-2.2		
		R-12.4		181/3	R-2.2		
152/2		R-12.1		181/4	R-1.5		
152/3		R-12.1		181/5	R-10.0		
152/4		R-12.1		181/6	R-4.1		
152/5	R-1.3	R-12.1		181/7	R-10.0		
152/6	R-1.4	R-12.5		181/8	R-1.5		
152/7	R-3.1			181/9	R-4.2		
156/1	R-1.1			181/10	R-2.2		
156/2	R-1.1			181/11	R-4.2		
				181/12	R-1.5		

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TABLE R-2 (Continued)

LOCATION OF RESPONSES TO COMMENTS

	Response Location				Response Location		
Letter/ Issue	USFS	EPA	Corps	Letter/ Issue	USFS	EPA	Corps
181/13	R-4.3			244/11	R-10.0		
181/14	R-1.5			244/12	R-4.1		
190/1	R-1.5			244/13	R-4.1		
194/1	R-3.1			244/14	R-4.1		
197/1	R-9.0			244/15	R-7.0		
197/2	R-4.2	R-12.4		244/16	R-1.2		
197/3	R-3.1			244/17	R-1.2		
202/1	R-3.2			244/18	R-1.2		
206/1	R-1.5			244/19	R-1.2		
206/2	R-9.0			244/20	R-2.3		
206/3	R-1.4			244/21	R-4.2		
206/4	R-5.2			244/22	R-4.1		
208/1		R-12.5		244/23	R-2.3		
208/2		R-12.5		244/24		R-12.2	
208/3		R-12.5		244/25	R-10.0		
208/4		R-12.4		244/26	R-10.0		
208/5		R-12.5		244/27	R-10.0		
208/6		R-12.5		244/28	R-10.0		
226/1	R-2.4			244/29	R-10.0		
230/1		R-12.5		244/30	R-10.0		
230/2		R-12.5		244/31	R-10.0		
230/3		R-12.5		244/32	R-7.0		
230/4	R-3.1			244/33		R-12.3	
230/5	R-3.3			244/34	R-2.1		
232/1	R-5.5			244/35	R-2.2		
232/2	R-5.4			244/36	R-2.2		
232/3	R-5.5			244/37	R-2.2		
235/1	R-1.4			244/38	R-2.3		
235/2	R-5.2			244/39	R-2.4		
235/3	R-5.2			244/40	R-2.2	R-12.2	
240/1	R-1.5			244/41	R-2.2	R-12.2	
244/1	R-2.3	R-12.2		244/42	R-2.4		
244/2		R-12.1		244/43	R-2.2		
244/3	R-2.1			244/44	R-2.2		
244/4		R-12.1		244/45a	R-2.3		
244/5		R-12.3		244/45b		R-12.4	
		R-12.1		244/46		R-12.4	
244/6		R-1.4		244/47		R-12.1	
244/7		R-12.1		244/48		R-12.4	
244/8	R-1.2	R-12.1		244/49		R-12.4	
244/9		R-12.4		244/50		R-12.1	
244/10	R-9.0			244/51		R-12.4	
				244/52		R-12.4	

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TABLE R-2 (Continued)

LOCATION OF RESPONSES TO COMMENTS

	Response Location				Response Location		
Letter/ Issue	USFS	EPA	Corps	Letter/ Issue	USFS	EPA	Corps
244/53		R-12.4		261/5	R-4.3		
244/54		R-12.4		261/6	R-2.3		
244/55		R-12.4		261/7	R-4.2		
244/56		R-12.1		261/8	R-1.3		
244/57		R-12.4		261/9	R-4.1		
244/58	R-2.3			261/10	R-4.1		
244/59		R-12.2		261/11	R-5.1		
244/60		R-12.4		261/12	R-2.1		
244/61		R-12.4		261/13	R-7.0		
245/1	R-5.2			261/14	R-7.0		
249/1		R-12.5		261/15	R-7.0		
251/1	R-1.4			261/16	R-7.0		
252/1	R-9.0			261/17	R-6.0		
252/2	R-9.0			261/18	R-8.0		
252/3	R-1.5			261/19	R-8.0		
252/4	R-4.3			261/20	R-8.0		
252/5	R-1.2			261/21	R-8.0		
252/6	R-1.4			261/22	R-3.2		
252/7	R-5.1			261/23	R-3.2		
252/8	R-5.2			262/1	R-4.3		
252/9	R-1.3			262/2	R-4.3		
252/10	R-3.2			262/3	R-1.3		
252/11	R-3.3			262/4	R-3.1		
252/12	R-4.3			262/5	R-5.4		
252/13	R-4.3			262/6	R-5.5		
252/14	R-1.5			262/7	R-3.1		
252/15	R-4.3			262/8	R-7.0		
252/16		R-12.4		262/9	R-7.0		
252/17	R-8.0			262/10	R-7.0		
252/18	R-9.0			262/11	R-8.0		
252/19A	R-6.0			262/12	R-8.0		
252/19B	R-9.0			262/13	R-5.4		
252/20	R-9.0			262/14	R-5.5		
258/1	R-2.2			262/15	R-5.3		
258/2	R-4.3			262/16	R-5.4		
258/3	R-5.4			262/17	R-5.4		
260/1		R-12.5		262/18	R-5.3		
260/2	R-1.4			262/19	R-5.3		
261/1	R-1.3			262/20	R-5.3		
261/2	R-1.3			262/21	R-6.0		
261/3	R-1.3			263/1	R-1.5		
261/4	R-1.2						

TABLE R-2 (Continued)

LOCATION OF RESPONSES TO COMMENTS

	Response Location				Response Location		
Letter/ Issue	USFS	EPA	Corps	Letter/ Issue	USFS	EPA	Corps
264/1	R-4.1			C2/5			R-11.2
264/2	R-4.1			C2/6			R-11.2
	R-4.3			C2/7			R-11.2
264/3	R-4.1			C2/8			R-11.3
266/1	R-4.3			C2/9			R-11.2
266/2	R-3.1			C8/1	R-5.2		
266/3	R-2.1	R-12.3		C8/2			R-11.3
266/4	R-6.0			C17/1			
267/1	R-5.4			C17/2			R-11.3
C1/1			R-11.3				
C1/2			R-11.1				
C1/3			R-11.1				
C1/4			R-11.1				
C1/5			R-11.1				
C1/6			R-11.1				
C1/7			R-11.1				
C1/8			R-11.1				
C1/9			R-11.1				
C1/10			R-11.1				
C1/11			R-11.1				
C1/12			R-11.1				
C1/13			R-11.2				
C1/14			R-11.2				
C1/15			R-11.2				
C1/16			R-11.2				
C1/17			R-11.2				
C1/18			R-11.2				
C1/19			R-11.2				
C1/20			R-11.2				
C1/21			R-11.2				
C1/22			R-11.2				
C1/23			R-11.2				
C1/24			R-11.2				
C1/25			R-11.2				
C1/26			R-11.2				
C1/27			R-11.3				
C2/1			R-11.2				
C2/2			R-11.2				
C2/3			R-11.2				
C2/4			R-11.2				

R-1 TAILINGS DISPOSAL

Numerous comments addressing the tailings disposal alternatives were received. Comments regarding the physical oceanography of the fjords, tailings behavior following discharge, and fjord modeling are addressed here in Sections R-1.1 through R-1.3, respectively. Comments regarding the wilderness and visual impacts associated with tailings disposal are addressed in Section R-1.4. Other comments concerned with tailings disposal, including on-land tailings disposal and issues related to the tailings pipeline, are addressed in Section R-1.5. Comments related to the chemical properties of tailings are addressed in Section R-2, Tailings Toxicity, while comments concerned with biological impacts of marine tailings disposal are addressed in Section R-4, Fisheries Impacts.

R-1.1 Physical Oceanography

One commentor (156/1-9) provided clarification regarding the circulation and density structure of Boca de Quadra and Smeaton Bay. Changes in response to these comments have been incorporated into the Final EIS, Sections 3.1.6 and 4.1.6. One of these comments stated that the mechanism driving the circulation of the fjords is still not clearly understood. This is a valid observation and should be kept in mind when reviewing the material related to tailings impacts.

R-1.2 Tailings Characteristics

A number of comments were concerned with how the tailings behave when they are discharged into either Wilson Arm or Boca de Quadra. Two commentors suggested text changes that would clarify descriptions of the behavior of tailings in the fjords (156/10-12 and 244/17). The text referenced by these comments has been clarified.

One commentor (244/8) attempted to reconcile a disparity regarding the outflow of metals in the upper 100 m of Smeaton Bay into the adjacent Behm Canal. In response, we note that the findings of Section 4.1.6.5 indicate that concentrations of fine particulates transported from Smeaton Bay to Behm Canal are predicted to be 1 percent of the tailings concentration at the top of the turbidity current. A value of 40 mg/l for the tailings concentration at the top of the turbidity current is reasonable, based on observations in Rupert Inlet and the Quartz Hill tailings discharge volume. This indicates that fines are not confined to Smeaton Bay but are transported over the sill. The sill, at 130 m, is deeper than the upper 100 m depth. Since metals readily bind to particulates, this flushing mechanism of the bay should prevent Smeaton Bay from acting as a sink for heavy metals. Therefore, the Forest Service believes that the interpretation which indicates greater dilution potential in Wilson Arm/Smeaton Bay is the correct interpretation. The EPA does not concur. Their response to this comment can be found in Section 12.1.

Because the Smeaton Bay entrance sill is deeper than the Kite Island sill in Boca De Quadra, Smeaton Bay communicates more freely with waters outside the bay. The Quartz Hill project will not modify the

circulation of waters above the Smeaton Bay sill. Based on Appendix S of the EIS, Smeaton Bay would not only circulate more effectively but this circulation would not be greatly affected by the proposed project.

One commentor (244/16,18) was concerned with the tailings concentrations reported in the Revised DEIS and, in particular, with the concentration of tailings at the top of the turbidity current. The actual concentration of tailings fines at the top of the turbidity current is difficult to predict. The commentor pointed out that the concentration of suspended tailings at the top of the turbidity current observed in Rupert Inlet (see Figure 4-6) is about 20 mg/l. We feel this value is too low to use for Quartz Hill. The Island Copper operation at Rupert Inlet discharged only half as much tailings as the planned discharge at Quartz Hill. The relationship between *in situ* tailings concentrations and the amount of tailings discharged is complicated by the amount of dilution, the efficiency of the mixing box, the behavior of the tailings in the near field, and the slope of the fjord bottom. Therefore, the tailings concentration at the top of the turbidity plume can be only roughly estimated. In the absence of more substantive information, we have assumed that the relationship between the amount of tailings discharged and the tailings concentration at the top of the turbidity current is directly proportional and that by doubling the amount of tailings discharged, the tailings concentration at the top of the turbidity current will also double. Therefore, an estimate of 40 mg/l has been adopted for the EIS analysis. Appropriate changes have been made to the text (Section 4.1.6).

Related to the concentration of tailings at the top of the turbidity current is the question of the quantity of tailings fines that will leave Smeaton Bay (244/19). The Revised DEIS presented a calculation on this amount that has been modified in the FEIS to reflect a concentration of tailings fines at the top of the turbidity current of 40 mg/l. The amount of fines leaving the fjord may be calculated by determining the volume of downfjord flow over the outer Smeaton Bay sill and dividing the calculation into two separate periods, deep water renewal and nondeep water renewal. The calculation steps are as follows:

> Outflow occurs in a layer above the Smeaton Bay outer sill between 60-m and 120-m deep (Nebert 1985). The width of the fjord at these depths is 932 and 708 m, respectively (interpolated from Findikakis 1985). The cross-sectional area of the outflow is 49,200 m^2.
>
> The average velocity of the outflow is 10 cm/sec during deep water renewal (May-September, a duration of 153 days or 13.2 million sec) and 5 cm/sec during nondeep water renewal (October-April, a duration of 212 days or 18.3 million sec) (Nebert 1985).

The concentration of tailings in this outflow is predicted to be 10 percent of the tailings concentration at the top of the turbidity current during deep water renewal and 1 percent of this concentration

during nonrenewal periods (Kowalik and Findikakis 1985). The tailings concentration at the top of the turbidity current is assumed to be 40 mg/l (see above).

Therefore, during deep water renewal, 65 billion m^3 of water flows out of Smeaton Bay carrying 260 million kg of tailings, while during nondeep water renewal, 45 billion m^3 of water flows out of Smeaton Bay carrying 18.7 million kg of tailings. This represents a total of 278 million kg of tailings or about 1 percent of the total annual discharge during the early part of the 80,000 ton per day (tpd) phase of the project. The circulation model predicted that, as Smeaton Bay is filled, the circulation in the fjord will become restricted and the amount of tailings fines over the sill will decrease (Kowalik and Findikakis 1985). Therefore, as Smeaton Bay is filled with tailings the amount of fines leaving the fjord will decrease. The text (Section 4.1.6) has been revised to indicate that up to about 1 percent of the total discharge might flow out of Smeaton Bay.

A similar calculation for Boca de Quadra is not possible because of the complex nature of the Kite Island sill area. Currents in this area are much higher. Net currents to the northeast of the island are inward while currents to the southwest of the island are outward (Nebert 1984). A good quality bathymetric map of the sill region is not available. However, because the forces driving the circulation of both Boca de Quadra and Smeaton Bay fjords are similar, it can be expected that about the same amount of tailings (1 percent) will leave the middle basin of Boca de Quadra and be distributed throughout the outer basin. One may note the similarity in tailings concentrations in the sill regions in Figures 4-10 and 4-13.

Several commentors expressed concern that Smeaton Bay may not have the storage capacity to hold all of the discharged tailings (261/4, 252/5). The Forest Service and EPA have reached different conclusions on this point. The EPA position is explained in Section R-12.1, page R-76. The Forest Service interpretation of the data indicates that Smeaton Bay has more than enough storage capacity for the tailings. The sedimentation model for Smeaton Bay, which incorporated cross-sectional information for the fjord (Findikakis 1985), was used to estimate the storage capacity of Smeaton Bay. All of the below-sill volume of the bay, as well as some of the above-sill storage volume in the upfjord end of Wilson Arm, would be filled with tailings by the end of the project. The model indicates that at a constant discharge rate, a significant amount of tailings would not escape Smeaton Bay until year 70. The total discharge in 55 years would be 1.5 billion tons and the total discharge in 70 years would be 1.93 billion tons. Therefore, of the volume available for storage in Smeaton Bay, only 78 percent would be occupied by tailings by the end of the project in year 55.

A 5 percent error in the total volume of tailings discharge is possible because of uncertainties in the _in situ_ tailings density. In this case, the percentage of available storage volume in Smeaton Bay occupied by tailings at the end of the project (year 55) would be

82 percent, which still does not indicate an overfilled condition. Section 4.1.6.5, discussing the Smeaton Bay discharge, has been revised to reflect this estimate.

R-1.3 Modeling

One commentor (261/3) requested clarification on how the mathematical models were used in the analysis of disposal alternatives. The questions presented in this comment have been addressed in the EIS text, Sections 4.1.1.2, 4.1.6.3, and 4.1.6.5. In addition, Appendix F now includes a detailed discussion of the modeling perfomed for the project.

One commentor (152/5) noted that the circulation (i.e., flushing) of fines is expected to be more effective in Smeaton Bay than Boca de Quadra, where such circulation would be more limited. We agree with the commentor. Another commentor (156/13) took issue with our model interpretation, which concludes that the fjord flushing effect will decrease over time as the fjord bottom is filled with tailings. We agree that interpretations derived from the models must be viewed with caution. However, we maintain that the models present the best indication of the impacts to the fjord resulting from tailings disposal.

The appropriateness of using modeling results from an inner basin Boca de Quadra tailings discharge to represent the impacts of a central basin only discharge was noted by one commentor (261/1,2,8). The commentor specifically questioned the assumption that "the plume from an inner basin discharge will be similar to that of a direct middle basin discharge" and stated a model similar to that for Wilson Arm may be more applicable. In a related comment (252/9), it was stated that the middle basin is the "legally required choice" of disposal sites under the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) and, therefore, the middle basin must be extensively modeled. We disagree that middle basin discharge is necessary, or that additional middle basin discharge modeling is required. Discharge of tailings to the inner basin of Boca de Quadra was simulated during the original modeling effort with the sedimentation and deposition model. The model was run until the density current flowed over the inner basin sill and into the central basin. The central basin was then modeled by representing the flow over the inner basin sill as a discharge on the outside of the sill (Figure R-1). Although a direct middle basin discharge was not modeled, the case representing discharge to the central basin after the inner basin is filled is sufficient to indicate the patterns of impact. This is primarily because the volume of tailings originally modeled to be deposited in the inner basin is small, when compared to the total below-sill volume of the middle basin, only 5 percent. The extra 5 percent of tailings spread out over the entire bottom of the middle basin would not appreciably change the predicted depositional profiles.

The circulation model was used to evaluate the discharge alternatives. As described in the main text of the EIS, model runs were made simulating the existing circulation (Figure 3-11) and hydrography (Figure 4-8a) of the fjord, as well as the distribution of tailings

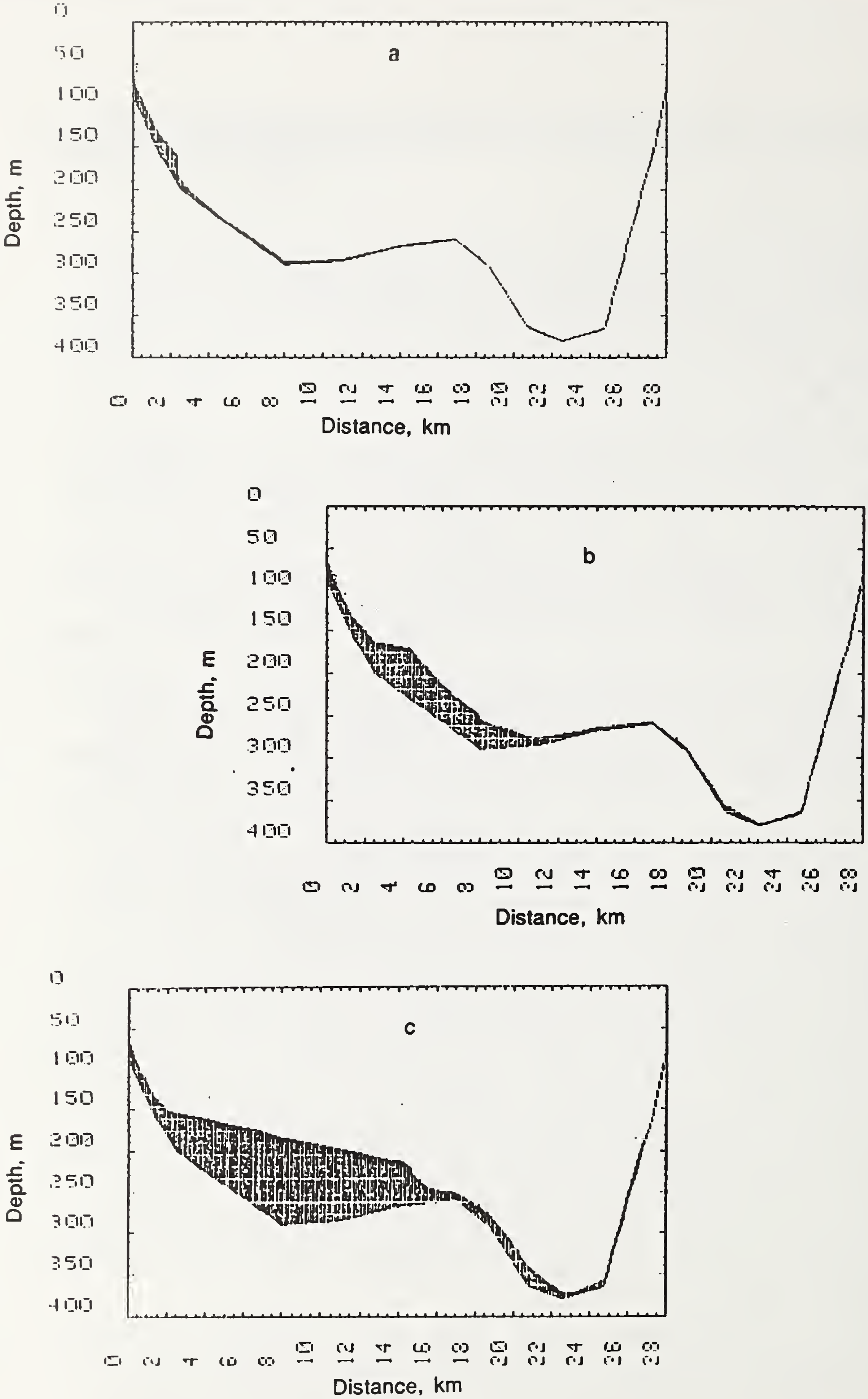

FIGURE R-1
TAILINGS DEPOSITION IN BOCA DE QUADRA FOR OUTFALL ON OUTSIDE OF INNER BASIN SILL FOR (A) 5, (B) 20, AND (C) 50 YEARS OF OPERATION
Source: Ryan (1983)

fines for an inner basin discharge (Figure 4-7a) and a middle basin discharge (Figure 4-10). These runs assumed that tailings discharge had not made substantial modifications to the bathymetry of the fjord. Impacts of tailings discharge near the end of the project were also made (circulation Figure 4-9; hydrography Figure 4-8b; tailings distribution Figure 4-7b). In this case, the bathymetry of Boca de Quadra was modified as predicted for the inner basin discharge. Although limited, this case is sufficient to indicate the impacts resulting from a middle basin only discharge. The inner basin discharge case may be used to simulate a middle basin discharge case for several reasons. The 1-km grid spacing of the circulation model does not have the resolution necessary to account for the additional volume of tailings for the middle basin only case. With a middle basin only discharge, the storage volume of the basin is reduced by an additional 5 percent and the driving mechanism for circulation in the inner basin will remain unaffected. Therefore, the circulation in the inner basin will not change because of a middle basin only discharge.

We believe these estimates are the best possible using the available information. They are more justifiable than using the models from Wilson Arm/Smeaton Bay, an area having entirely different bathymetric and oceanographic conditions. We have made changes in the text of Appendix G, Section 11-2 to clarify methods used in estimating plume distribution.

One commentor (262/3) requested that the Forest Service address the confidence levels associated with the modeling efforts for the tailings disposal in Wilson Arm/Smeaton Bay. The modeling efforts are based on numerous assumptions and limitations that are described in the EIS. These define the usefulness of the model. It is believed that these modeling efforts provide the best tool available for predicting impacts to the fjord. Based on these efforts, the results provide a reasonable scenario of the behavior of the tailings following underwater disposal. As with any modeling effort, a degree of uncertainty about results exists related to the quality of the assumptions and the number of limitations imposed. Therefore, U.S. Borax has agreed to a monitoring plan to verify modeling results. Borax has also agreed to contingency plans to modify operational procedures in the event that actual experience does not conform with expectations based on the modeling results.

R-1.4 Wilderness and Visual Impacts

Several commentors were concerned with the visual and/or wilderness impacts of ancillary facilities (tunnel, road, or pipeline) and activity (construction, maintenance, monitoring) related to tailings disposal. Most commentors expressed a locational preference for tailings disposal in Wilson Arm or Boca de Quadra, depending on the physical attributes they valued most.

One commentor (93/1) stated that the impacts of the Boca de Quadra tailings disposal alternative involve more than the visual and aesthetic effects associated with the tunnel portal being situated in the wilderness area. The commentor noted additional effects including

wilderness acreage that would be disturbed by land disposal of the tunnel rock, the general disturbance from operation and monitoring of the discharge operation, and the disturbance associated with the transport of materials and personnel to the portal area during the 55-year mine life. The commentor summarized the concern by requesting that all detrimental impacts be avoided if a reasonable alternative is available.

Impacts associated with the Boca de Quadra tailings disposal alternative mentioned above, in addition to the specific visual and aesthetic resource issues, are addressed throughout the EIS and in Section II of Appendix A. We agree with the commentor, and the preference to avoid all possible detrimental impacts to the wilderness is apparent in the Preferred Alternative statement that is located in the Summary section of the Final EIS. This statement reflects the preference of the Forest Service for the Wilson Arm tailings disposal alternative so that impacts of the mine development are confined to a single drainage and impacts on wilderness values can be reduced.

One commentor (152/6) questioned the logic of the Environmental Protection Agency's (EPA) preference for the Boca de Quadra tailings disposal alternative in light of their proposal to mitigate its accompanying impacts through agency actions. The commentor notes that with essentially the same marine impacts of the two disposal scenarios, the opportunity exists to limit impacts to a single drainage basin and, therefore, eliminate the need to mitigate wilderness impacts. Another commentor (244/6) emphasized the need to continue to give full consideration to avoiding impacts to more than one drainage basin and avoiding impacts to the wilderness areas, as these issues were prime arguments in the early stages of the project and continue to be valid concerns.

We agree that it is of great importance to minimize and, if possible, eliminate impacts to the wilderness area. Following a full evaluation of the environmental consequences of the two tailings disposal alternatives, the Forest Service has determined that it is possible to eliminate direct wilderness impacts associated with tailings disposal and, hence, has recommended the Wilson Arm tailings disposal project configuration.

One commentor (251/1) stated that there is no discussion of wilderness values or the wilderness resource as defined by law, as is called for under the provisions of ANILCA and the Wilderness Act. The commentor further suggested that a number of long-term impacts on the wilderness could be minimized by having a wilderness specialist review, on-the-ground, the wilderness values and potential impacts.

The commentor is referred to Section 3.0 of the EIS where discussions of discrete components of the Affected Environment are located. Subsection 3.3.5, Wilderness, provides a detailed discussion of the value of wilderness areas, plus the intent of the Wilderness Act and provisions of ANILCA that have set aside wilderness areas to be preserved. This subsection further discusses the measurable wilderness value components (e.g., natural integrity, apparent naturalness,

opportunities for solitude, opportunities for primitive recreation, and supplemental attributes such as ecological, geological, scenic, and cultural values) and the correlation between these measurable values and the attributes that characterize the Misty Fiords Wilderness. Section 4.3.5 discusses projected project impacts upon these wilderness values. Analysis by a different specialist would not contribute to the evaluation of the environmental consequences of the project upon the wilderness, beyond what is discussed in Subsection 4.3.5, nor would it have any effect on the level of impacts on wilderness resources.

Recognition of the responsibility of the Forest Service to protect the resources of the Misty Fiords Wilderness is apparent not only in the Service's implementation of the National Environmental Policy Act (NEPA) process through the preparation of this environmental impact statement, but also in the recommendation of a project configuration (Wilson Arm tailings disposal) that would eliminate project impacts within the wilderness boundary. The Service's recommendation follows a comprehensive evaluation of project impacts and reflects its responsibility to preserve the designated wilderness area.

Two commentors (176/4, 206/3) objected to the conclusion that locating the tailings disposal in Wilson Arm would reduce impacts on the wilderness, when, in fact, the entire project will be located in the middle of the wilderness area. One of these commentors stated that if it makes sense to locate such a project in the middle of a wilderness, then it makes as much sense to locate the tailings disposal in Boca de Quadra where it reduces the risk to a renewable resource (fisheries).

The terms "wilderness" and "wilderness values" used in this EIS relate specifically to the land area designated for protection by Congress under the Wilderness Act rather than to a pristine environmental setting. The mine site, while surrounded by the Misty Fiords National Monument Wilderness, is not actually part of the wilderness, nor is the Wilson Arm tailings outfall (see Figure 2-1 of the EIS). Only the Boca de Quadra tailings disposal alternative involves the construction of facilities in the wilderness itself (see Figure 2-2 of the EIS).

The Forest Service is required, through the Wilderness Act and ANILCA, to minimize adverse effects on wilderness. While the wilderness impacts of tailings disposal in Boca de Quadra are not represented in the Revised DEIS as being very significant, such impacts would be distinctly present for the Boca de Quadra alternative and not for the Wilson Arm alternative. Tailings disposal in Wilson Arm is therefore clearly consistent with the requirement to minimize wilderness impacts.

Three commentors (252/6, 171/2, 235/1) raised similar issues regarding impacts to fisheries and values of the Monument. One commentor (252/6) stated that "under the more reasonable EPA prediction that substantially less environmental impact would result from disposal in Boca de Quadra (impacting a small and localized segment of the wilderness area) than in Wilson Arm, the middle basin alternative is more in accordance with wilderness values (particularly since the

entire mine project is in the center of Misty Fiords Monument Wilderness)." The commentor also suggested that the Forest Service position for a preference for tailings disposal in Wilson Arm lacks merit because tailings disposal in this water body will preclude an underwater transmission intertie, thereby forcing the selection of an overland route (with its environmental consequences) through the wilderness.

As noted in the previous response, the Boca de Quadra alternative would involve negative effects on wilderness values that the Forest Service is obligated to avoid, if possible. Further, as noted in both the Revised DEIS and the Final EIS, there is little difference in effects to the marine environment between the two tailings disposal alternatives. With respect to the intertie, the commentor is referred to responses in Section R-6, Transmission Line.

One commentor (35/2) expressed concern regarding the significance of the visual and aesthetic effects of the tunnel portal on Boca de Quadra's shoreline. The comment further pointed out the "significant clearing, excavation, and concrete construction," as well as "temporary, and perhaps permanent, access to the area" that would be required to develop the tunnel portal. The commentor discusses the undoubted visible evidence of construction activity to visitors to Boca de Quadra.

Aesthetic impacts are addressed in Section 4.3.7, page 4-272 of the Revised DEIS under the heading, Tailings Disposal in Boca de Quadra. This subsection discusses approximate acreage that will be disturbed to accommodate construction of the tunnel portal, the inconsistency of the proposed activities with the Forest Service goals for managing the visual quality of the shoreline landscapes of Boca de Quadra, and the moderately significant visual impact classification that has been assigned to this project alternative. We agree with the commentor that the tunnel portal would be very noticeable to visitors to Boca de Quadra. It was the comparatively small extent of area disturbed that led to the moderately significant (rather than very significant) impact rating.

One commentor (260/2) expressed a preference for the recreational opportunities of Boca de Quadra in comparison to those of Smeaton Bay. The commentor attributed the preference to the presence of interesting features such as an old cannery, a fish hatchery, numerous islands and beaches, an interesting drift, and the evidence of previous use of the area (primarily at the mouth of the Keta River) by Indian cultures. The commentor then stated a preference for the Wilson Arm/Smeaton Bay tailings disposal alternative based on keeping all development activities in one bay and leaving the other (Boca de Quadra) in its "natural state." The commentor's preference for tailings disposal in Wilson Arm is acknowledged, and is consistent with the Forest Service preference for Wilson Arm disposal and corresponding minimization of wilderness impacts.

R-1.5 General Tailings Disposal Comments

Several other comments were received regarding tailings disposal. Most addressed impacts related to the tailings pipeline or requested further consideration of on-land tailings disposal. Other comments concerned impacts to diving birds and possible beneficial impacts on shallow basin habitat.

One commenter (181/12) inquired about the polypropylene entering the marine environment as a result of sloughing from the plastic pipes. We believe there is little or no cause for concern about sloughing or leaching of polypropylene. Polypropylene is inert and largely nontoxic in the marine environment. Considerable backing in the scientific literature includes the work by Sneitzer (1986), who used polypropylene fibers to construct an artificial fish habitat and reported that it was safe and presented no potential for pollution. Khlopova et al. (1981) used polypropylene fibers to simulate plant strands, and found that eggs deposited by fish were not traumatized by the substrate, and noted that the artificial substrate was highly resistant to wear, presenting little or no pollution threat. Any potential for toxicity will depend on the specific formulation used. If potentially toxic dialkyl phthalates or other plasticizers were included with the piping in significant quantities, for example, the toxic potential could be increased as a result of leaching of phthalates into receiving waters. However, while they do not biodegrade, minute fibers of abraded pipe material are insignificant in the context of the receiving environment. Sloughing of these compounds does not present cause for concern.

One commentor (137/1) expressed concern over potential pollution resulting from the use of diesel oil during the recovery of molybdenum. The seven-barrel-per-day figure cited by the commentor appears to be in error, as U.S. Borax (1983a, page 8-40) reports that diesel oil used to process ore will accompany the molybdenite concentrate and will not be disposed with the tailings. The actual discharge into the fjord represents a diesel oil discharge concentration of 0.01 ppm in the seawater/tailings slurry. Diluted at a 1:1 ratio, this would correspond to 7.1 lb/day. Discharge concentrations on the order of 0.01 ppm are not expected to exceed the predicted "no effect" concentration of diesel oil for chronic toxicity to aquatic life. Petroleum hydrocarbon residues discharged into fjords are expected to readily degrade over time, especially the lower molecular weight fraction found in diesel oil.

The National Marine Fisheries Service (NMFS) (181/4) stated that the probability and frequency of ruptures in the tailings pipeline and malfunctions of the tailings discharge apparatus are not adequately addressed in the Revised DEIS. The commentor requested the running of a spill frequency and effects model to estimate potential impacts, presumably on salmon populations. In response to this comment, a worst-case analysis was performed for three spill scenarios using existing information: 1) a pipeline rupture near the middle section of Tunnel Creek, 2) a pipeline rupture near the mouth of Tunnel Creek at Wilson estuary, and 3) a rupture in the tailings pipeline along Wilson

Arm. The first scenario appears to be the worst, as the ultimate effect could be the loss of about 27,000 returning adult salmon. This impact scenario has been added to Appendix G at the end of Section 16-C (Biological Effects Assessment). However, this worst case expression of salmonid vulnerability greatly exaggerates the real risks to the fishery, because the likelihood of a spill approaches zero.

New information about tailings pipeline wear characteristics, pipeline monitoring and maintenance, and spill containment systems has been provided by U.S. Borax. Collectively, this information indicates that the risk of pipeline rupture is lower than previously understood, that methods for detecting a rupture have improved, and that spill containment measures would be adequate to prevent tailings from reaching sensitive aquatic environments. Given these considerations, the risk to aquatic populations is insignificant. A full discussion of spill likelihood and containment has been added to Appendix G, Section 16-B (Risks of Breaks in Mill Tailings Pipelines). Section 4.2.1.4 has also been appropriately revised.

One commentor (252/14) stated that the Revised DEIS did not address adequately the mitigation associated with wear in the mill tailings pipes. This commentor noted in Appendix G, Section 16-B, that an expected lifetime for a mill tailings pipe was from 4 months to 3 years. This estimated pipe lifetime, although incorrect, led the commentor to request an assessment of alternative pipeline materials and possible effects that they may have on the regional environment as a result of internal wear. There are two elements to our response. First, the estimated lifetime of the tailings pipe is at least 10 years, instead of 3 years or less mentioned in the Revised DEIS. The new estimate is based on U.S. Borax's more recent experiences with using high density polypropylene pipes for carrying mill tailings. It is reasonable to assume that, given this reduced wear rate, particulate concentrations of polypropylene in the disposed tailings would not be sufficient to adversely affect aquatic organisms. Polypropylene is chemically inert, and its physical properties do not pose a significant risk to aquatic habitats at concentrations expected from long-term internal pipe wear.

Second, the assessment of risk to aquatic environments resulting from a tailings pipeline rupture has been substantially revised. This revision appears in Appendix G, at the end of Section 16-B, along with a new statement about the expected lifetime of the tailings pipes. The risk assessment acknowledges a containment system for spilled mill tailings that would prevent their uncontrolled discharge into aquatic environments. Given this containment system, inclusive of parallel trenches and catch basins, the likelihood of spilled tailings reaching unplanned disposal sites is insignificant. Additionally, the monitoring systems to be used for internal wear and rupture detection will allow appropriate measures to be taken in advance of serious releases of spilled tailings. These, too, are discussed in Appendix G, Section 16-B.

The NMFS (181/8) noted an error in referencing Section 4.1.6.2 for discussion of pipeline ruptures because pipeline rupture impacts were not discussed in the referenced section. In addition, the commentor felt that such a rupture has potential for affecting a yearclass of salmon if it were to occur during a spring phytoplankton bloom. In response to the editorial comment, the text has been corrected to refer to Section 4.2.1.4 for pipeline rupture discussions. Concerning the comment on phytoplankton, impacts on spring phytoplankton blooms are not considered nearly as serious as direct impacts on salmon populations, as discussed above in response to comment 181/4. Given this extensive discussion on direct impacts, and the extremely small likelihood of their occurrence, additional discussion of potential impacts on phytoplankton blooms is not necessary.

Several commentors (90/1, 108/1, 171/1, 173/1, 174/1, 190/1, 206/1, 240/1, 252/3, 263/1) requested further study or explanation of on-land tailings disposal. On-land tailings disposal has been addressed in EIS text Sections 2.5.3, 4.1, and 4.2; and Appendix A, Section III.F.5. On-land tailings disposal would completely eliminate the salmon spawning area in Tunnel and Aronitz Creeks (about 1.4 percent of the project area salmon production). This complete and irrevocable loss is much more significant than the expectation of no impacts associated with marine tailings disposal. On-land tailings disposal would require huge dams to contain the tailings. Those tailings dams would be some of the highest dams in Alaska, and they would have major adverse visual effects. If the dams were breached due to an earthquake, the consequences downstream would be catastrophic. Even a very large rainfall could cause serious water quality impacts. The on-land tailings alternative would eliminate more area of vegetation and wildlife habitat than all the rest of the project components together. Backfilling the mine with tailings is not feasible due to the way the mine must be operated and because the volume of tailings would be larger than the pit from which the ore was removed. The impacts of the tailings reservoirs would occur even with backfilling.

The environmental consequences of on-land tailings disposal have been determined to be larger than marine tailings disposal, even without considering economics. This conclusion was not questioned by any of the regulatory agencies that commented on the DEIS or Revised DEIS.

The NMFS commented (181/14) that dumping of tailings into the deep middle basin of Boca de Quadra would have less impact on diving birds and mammals. We disagree with this comment. The mechanisms by which diving birds or mammals might be impacted by tailings appear to fall into two categories. Direct impacts would occur if tailings toxicity could affect diving birds or mammals or if turbidity caused disorientation or other effects. Indirect effects would occur if the prey of diving birds or mammals are reduced in numbers or availability or become toxic. Tailings will not be acutely toxic and toxic metals will not bioaccumulate or biomagnify (Appendix G, Section 12). Therefore, the brief excursions into a tailings plume that would be the worst exposure imaginable for diving birds or mammals would not have toxic effects, and the prey species would not become toxic by bioaccumulation or biomagnification of metals. Tailings are not

expected to affect the upper water column of either fjord where most food organisms occur, because the mechanisms to move tailings into the upper waters could, at worst, be brief and local. As a result, no effects on diving birds or mammals are envisioned for either fjord under worst-case conditions.

One commentor (56/1) stated that Wilson Arm/Smeaton Bay should be the preferred alternative for tailings discharge based on minimal environmental impacts and ecological benefits of a discharge into a shallower basin. This commentor also presented several document citations that he stated helped confirm his opinions. The cited documents have been reviewed. Although these articles present some new information, the inclusion of this information into the Final EIS will not substantially change the discussion presented and, therefore, are not being included. However, we concur with the conclusion that Wilson Arm/Smeaton Bay should be the preferred alternative.

R-2 TAILINGS TOXICITY

Numerous comments addressed the toxicity of the tailings. Subsection R-2.1 includes comments and responses concerning state and federal water quality standards, particularly the EPA's Total Recoverable copper standard. This subsection also includes comments concerning the proposed seawater to tailings ratio, because the ratio affects the concentration of metals in the discharge and thereby affects whether the receiving waters meet water quality standards after the addition of the tailings. Subsection R-2.2 focuses on the bioavailability of toxins; that is, of the amount of toxic metals found in the discharge, how much is in a chemical state which can affect fish and other marine organisms? Comments pertaining to reagents are discussed in Subsection R-2.3. Other miscellaneous tailings toxicity comments are addressed in Subsection R-2.4.

R-2.1 Water Quality Standards

One commentor (148/1) requested clarification in the EIS regarding the proposed initial dilution of tailings in seawater at the point of tailings disposal. The dilution ratios discussed in the Revised DEIS on pages A-39 and 2-6 are based on pilot plant testing, and varied from 4:1 to 1:1. Ratios of seawater to tailings (freshwater slurry from the mill at 40 to 50 percent solids by weight) in the range of 4:1 to 5:1 may be more representative of actual tailings discharge to the fjord floor (mixture of seawater slurry from the mill). Similar tailings disposal systems are currently being designed with up to a 6:1 ratio. The final ratio has not been determined; thus, analyses were performed assuming the worst-case 1:1 ratio.

The same commentor (148/3,10) noted that increasing the seawater to tailings ratio from 1:1 to 5:1 would greatly reduce the resulting dissolved copper concentrations, and that the tailings should be further diluted to reduce toxicity to recreationally important fish species. He commented that initial copper concentrations estimated from bench-scale and pilot-plant tests are considerably lower than the 11.87 ug/l cited in Table 4-8 of the Revised DEIS. Another commentor

(244/5) noted that the 1:1 seawater to tailings ratio used to produce the 11.87 ug/l initial dissolved copper concentration was artificially low, and that the latest results from the pilot plant shows a more credible range of 0.219 to 1.19 ug/l. We agree with these comments; the predischarge dilution factor of 1:1 seawater to tailings is conservatively low, and does not reflect the most recent pilot plant results. Jain and Kennedy (1984) studied three levels of seawater to tailings ratio (1:1, 2:1, and 4:1), and found that the integrity of the tailings plume was maintained at all three levels. Increased predilution would reduce projected initial concentrations of copper within the mixing zone to nontoxic levels. Borax has stated its willingness to use a seawater to tailings ratio of 4:1 or even 6:1, which would reduce initial dissolved copper concentrations still further. The effect of a higher dilution ratio, such as 6:1, would be to dilute the recoverable copper concentration up to six-fold, producing a copper concentration of 1.98 ug/l at the point of initial discharge and dilution (i.e., within the mixing zone). Concentrations of this level would not be sufficient to induce toxicity according to the EPA water quality criterion for copper toxicity (i.e., 2.9 ug/l).

The same commentor (148/9) expressed further concern that the EPA toxicity criteria are too conservative and may not be reflective of concentrations at which mortality of marine organisms will actually occur. Another commentor (266/3) noted that the 2.9 ug/l acute toxicity value for copper should be investigated on a site-specific basis. The issue is not whether toxicity will occur to all exposed organisms. The issue is whether the saltwater final chronic value of 2.9 ug/l will be protective of marine organisms and their uses. The 2.9 ug/l is the estimate of the safe level for chronic exposure of marine species to copper, and it is based on copper's chronic toxicity to the bay mussel *Mytilus edulis*, a marine organism that occurs in the fjords. The commentor is correct in stating that the 2.9 ug/l may not always be toxic to local species. U.S. Borax has the prerogative of developing site-specific data which could be used to develop site-specific water quality criteria. In the absence of such site-specific data, the 2.9 ug/l remains the criterion for copper.

U.S. Borax (244/33) questioned the applicability of the Total Recoverable Concentrations (TRCs) for evaluation of potential impacts in the density plume and near field since the density current is not an appropriate habitat for marine organisms. Use of the TRCs is the only way expected concentrations can be compared to applicable EPA water quality criteria. It is understood that the plume will not be a habitat area; however, the intent of the analysis is to evaluate the point at which EPA quality criteria can be met. No change to the EIS is required.

U.S. Borax (244/34) commented that the analyses of fjord water quality are extremely conservative and that even so, water quality standards are met except for the few cases noted. This comment is noted. No change to the text is required.

One commentor (261/12) noted that the addition of the extractable portion of the metals concentration to the total metals concentration in the outfall contaminant analysis significantly increases the projected copper concentrations as well as iron, manganese, and molybdenum (Appendix E, page E-30). It was also noted that the table on this page uses a mixture of acute and chronic water quality criteria, and that both should be cited. We concur with these comments and the text has been changed accordingly to reflect this additional information.

One comment (156/3) noted that minimal degradation of the upper water column will occur because of tailings discharge to either fjord. This has always been the position of the Forest Service, as reflected in the EIS.

R-2.2 Metals Bioavailability and Impacts to Fish

One commentor (148/2) noted that the acidification step used in determining total recoverable copper portrays copper concentrations as being considerably higher than the expected bioavailable fraction in the environment. We agree with the commentor that total recoverable copper does not accurately reflect the actual bioavailable (i.e., dissolved) fraction, unless unusual circumstances were to arise in fjord bottom water (i.e., prolonged anoxia or protracted periods of highly acid pH (e.g., less than 5). Such conditions are not expected.

One commentor (148/5) inquired about the number of fish expected to suffer acute mortality from copper, and asked if this outweighs the terrestrial impacts of using Boca de Quadra for tailings disposal. In response, the number of fish suffering acute toxicity as a result of the tailings discharge is not known. However, it has been determined that the risk to the fjord and the fishery is sufficiently small that it does not preclude tailings disposal in either fjord. When all factors are weighed (not just acute copper toxicity and terrestrial impacts), tailings disposal in Wilson Arm is preferred.

One commentor (148/6) inquired as to whether evidence exists to suggest significant levels of acute copper toxicity on fish living outside the mixing zones at Island Copper and Kitsault, and inquired about the dissolved copper concentrations at those sites. Studies at Island Copper Mine and Kitsault showed that acute copper toxicity was not a problem. Goyette and Nelson (1977) showed that the major biological impact appeared to be the burial of marine biota rather than chemically induced toxicity. Goyette and Christie (1982), in studies on the receiving water for the Amax/Kitsault mine, found no leaching under normal seawater conditions, while indicating a potential for leaching under mildly acidic conditions created in the laboratory. They found no evidence of acute toxicity, and found that elevated concentrations of various metals at the sediment-water interface are returning to predischarge (baseline) levels following termination of discharge.

Goyette and Christie (1982b) reported elevated lead, copper, and other metals in biota relative to controls from the Kitsault mine area (Hastings Arm and Alice Arm), especially in algae and tissues of

mussels. Concentrations of various metals in sediment were found to be elevated relative to control sediments as well. This does not, however, indicate that adverse effects to biota are occurring as a result of this exposure. It is not possible to delineate whether significant toxicity has occurred since abandonment of these operations, but benthic organisms collected in the areas impacted by tailings from these two mines have survived with elevated tissue concentrations[1/]. It thus appears that either (1) mine discharges have not adversely impacted the benthic biota, or (2) the organisms may have acclimatized to the elevated ambient concentrations of copper and other metals.

One commentor (148/7) inquired as to why the potential effect of acute copper toxicity on fish is of concern at 11.87 ug/l, when there are data suggesting that LC50s are much higher (i.e., less toxic) for several salmon species likely to be exposed to the tailings. The same commentor (148/8) expressed the same concern regarding the sensitivity of commonly caught sport fish. We do not agree with the commentor's implication that the higher copper concentrations acceptable to some species are indications that there should be no concern at 11.87 ug/l. First, the commentor cited 1976 EPA data that have since been updated. More importantly, the species cited are tolerant to acute intoxication by copper, while water quality criteria are designed to protect 95 percent of all species, and all economically important species, from both acute and chronic toxicity. It is not adequate to protect only a few of the economically important species. Here the main toxicological issue is whether there will be significant chronic toxicity beyond the mixing zone of the discharge.

If the copper concentration of 11.87 ug/l were attained, it would be expected to be toxic to some species of aquatic organisms. The preferred approach to avoiding such a level is to increase the seawater to tailings ratio above 1:1. For copper, both the Final Acute Value and the Final Chronic Value have been set at 2.9 ug/l. At seawater to tailings ratios of 5:1 in the initial mixing chamber, dissolved copper concentrations would be reduced to less than 2.9 ug/l.

One commentor (181/2) noted that the question regarding uptake of metals by biota is unresolved, and suggests that uptake could occur in the same manner as has been shown in other studies. We disagree with the commentor. As stated in the Revised DEIS (page 4-130), the bioaccumulation potential of the proposed tailings is thought to be negligible, verified by 1 to 4 months of testing with both invertebrates and fish. Bioconcentration factors stated in the EPA water quality criteria indicate generally low bioconcentration potential for those compounds found in the tailings, mainly because the organisms can excrete these metals so readily. The potential for bioaccumulation in aquatic life will depend on the concentrations of bioavailable metals to which organisms are exposed as well as the types

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1/ For example, up to 149 mg/kg dry weight whole body in shrimp at Howe Sound, up to 363 mg/kg in bivalves at Alice Arm, and up to 10.4 mg/kg in Dover sole muscle tissue at Quatsino Sound.

of metals themselves. Of equal importance is how the organism processes the metal; whether, for example, it readily excretes the contaminant or whether it accumulates the contaminant via enzyme detoxification pools. The most sensitive organisms are those that accumulate contaminants faster than they detoxify them. For the proposed mine, this is not expected to be a significant problem due in large part to low dissolved concentrations of free metal ions (the most bioavailable constituents) in mine tailings.

An example of what is expected in the fjord receiving waters is given with methyl mercury, which has a high bioconcentration factor due to its fast uptake and slow depuration. The biological half-life of mercury in fish is expected to be 2-3 years. However, methyl mercury is not expected to predominate over inorganic mercury in the tailings discharge. Even for inorganic mercury, concentrations are expected to be low and it is therefore not of concern (from Table 4-8, the expected discharge concentration is 0.4 ug/l).

One commentor (181/3) stated that toxicity information provided in the Revised DEIS is insufficient to evaluate effects on biota, and suggested the repeating of bioassays. While we agree that bioassays should eventually be repeated, we also believe that current information is adequate to support this EIS. In tests with four representative marine species, EVS (1984b) found that Quartz Hill tailings were not acutely toxic to marine organisms. These studies were designed with the intent of representing in situ conditions following tailings discharge to the fjords, and provide useful information.

Some conclusions derived by EVS (1984a, 1984b), however, are questioned because of study design and test performance (e.g., high mortality in controls). Regarding chronic toxicity potential, it is noted that EVS (1984b) did not evaluate chronic toxicity as it is normally done today. Current procedures include testing for survival, growth, and reproductive success, with reproductive success the most sensitive endpoint. Chronic toxicity, therefore, was not well characterized by the EVS testing. The above inadequacies do not necessarily indicate that conclusions regarding toxicity and bioaccumulation are incorrect. The tests did indicate that crab zoeal growth and development were not affected by chronic exposure to tailings, and that over a 16-week exposure period, no effect was observed on clam burrowing behavior.

One commentor (244/35) noted that the Total Recoverable fraction used by the EPA is an oversimplification and does not reflect the actual bioavailable fraction in the receiving water environment. We agree with the commentor. In fjord receiving water environments such as Boca de Quadra and Smeaton Bay, the suspended solids concentrations in the vicinity of the tailings discharge are expected to be high, thus reducing the dissolved concentrations while increasing the sorbed fraction. In addition, no major variation in bottom pH is expected in either fjord (i.e., bottom pH is not expected to become highly acidic), which could cause mobilization of sorbed or complexed metal ions.

The EPA-established Total Recoverable fraction is used because the agency has elected not to use chemical speciation models to define the actual concentrations of bioavailable copper. Unless unusual circumstances prevail, it is not expected that the sediment-bound metals will be mobilized (i.e., leached) into the water column. This is supported by the findings of Goyette and Christie (1982b) in their work on leachability of trace metals from the Amax/Kitsault mine tailings. Moreover, only low to moderate concentrations of metals were detected in the tissue of benthic organisms.

The same commentor (244/36) contended that the findings of the EVS bioassays are basically sound, and the findings indicate that there is little or no potential toxicity resulting from tailings discharge, as tests were conducted with a wide range of organisms using varied habitats and feeding strategies. We partially agree with the conclusion of the commentor. Data from the EVS bioassays do provide useful information, particularly with respect to acute toxicity. However, due to the incompleteness of the tests, there are insufficient data available to decide independently to what extent chronic toxicity, bioaccumulation, and other factors will be worthy of concern. It would not be sufficient to interpolate findings from other mines (e.g., Island Copper Mine) when there may be substantial differences in the Quartz Hill discharge from the tailings studied at other mines. Further testing will be required as a condition of the NPDES permit before the plant goes into operation in order to make these determinations.

One commentor (244/40,41) believes the results from EVS vis-a-vis tailings toxicity were valid, and specifically responds to the criticism in the Revised DEIS of allowing suspended particulates to settle and of survival of control organisms. The Forest Service and the EPA maintain the position that the EVS studies did not satisfactorily resolve all issues concerning toxicity to marine organisms, due in part to the methodology used. Allowing suspended particulates to settle is not representative of a situation in the field, where suspended particulates are constantly renewed from the discharge and may create a different scenario from that of testing in the laboratory. The EPA's position on this question is discussed in more detail in Section 12.2.

One commentor (244/43) contended that while poor survival of crab zoea occurred in EVS tests, the validity of the many other tests was not in any way affected. We disagree with the commentor. We believe that the high mortality of crab zoea is unacceptable, and although EVS did not include the results of these tests with the overall findings, this is still a flaw. On the positive side, use of analytical verification of nominal concentrations, sufficient exposure periods, adequate controls, and consultation with the EPA probably means that the findings have some validity and may reflect an actual lack of toxicity expected to occur *in situ*. These favorable findings are borne out by other work.

One commentor (258/1) expressed concern over the effect of metals, particularly nickel, in tailings on the anadromous fishery, and stated that protection of the fishery deserves high priority. The recent

studies in Puget Sound to which the commentor referred concern the concentrations in sediment and effects of polynuclear aromatic hydrocarbons and other contaminants on flatfish in Puget Sound, rather than the effects of nickel from mining discharges. We do not believe that the two situations can be compared. Nickel is not regarded as a strong potential carcinogen. Data from pilot tailings assays show that nickel is not expected to occur in high concentrations in the tailings discharge beyond the mixing zone and, as such, should not pose a serious threat to the anadromous fishery. Regarding the potential for carcinogenesis, Doll et al. (1977) found that nickel derivatives were found to be carcinogenic when subjected to a process which has been abandoned since the 1930s, but since that time it has been concluded that there are no data in support of nickel as a potential carcinogen either to humans or to fish.

One commentor (244/44) noted that metal concentrations in the tailings are generally not elevated above natural sediment concentrations in Boca de Quadra except molybdenum, providing an explanation as to why metals from tailings are not bioaccumulated. This comment is noted.

One commentor (181/10) noted an apparent discrepancy between the Revised DEIS and the EPA Best Professional Judgment (BPJ) (EIS Appendix S), where the former states that no problem of biomagnification is expected while the latter reports biomagnification of cadmium at lower trophic levels. In response, cadmium biomagnification has not been documented to be transmitted through upper trophic levels (European Inland Fisheries Commission 1983). Transmission from primary producer to grazer is not considered acceptable evidence of biomagnification. The confusion, however, is understandable, in that Biddinger and Gloss (1984) define biomagnification as "the total process of bioaccumulation by which tissue residues of toxic substances increase as material passes up through two or more trophic levels."

Generally, biomagnification is not expected if the organism is able to metabolize and/or excrete the compound. Biddinger and Gloss (1984) report that shellfish can accumulate dangerous levels of cadmium, arsenic, methyl mercury, phosphorus, and silver. These compounds are bioaccumulated and represent a potential threat to consuming organisms feeding heavily on contaminated shellfish. In order to avoid confusion on the two terms of bioaccumulation and biomagnification, the wording in the EIS on page 4-132 has been modified.

R-2.3 Reagents

One commentor (244/1) stated that no more information is needed on the milling reagents in order to determine that they do not present a toxicity problem, and stated that a comparison to other mines should be made. It has been determined, based on the bioassays performed for the proposed mine (EVS 1984a, 1984b), that sufficient information currently exists to make a negative finding regarding aquatic toxicity potential of the proposed tailings. Even so, the issue of milling reagent toxicity has not been satisfactorily resolved due to incomplete characterization of milling reagents at the time of testing. The

concentrations of the milling reagents were not ascertained during the course of all testing, and therefore could not be assumed to be representative.

Prior to initiation of mining operations, further testing of tailings will be required as a condition of the NPDES permit. Of particular concern may be the quaternary ammonium polymers M502 and SF330, known to be toxic to a variety of aquatic and marine species (Calgon 1987; Boethling 1984).

Regarding toxicity testing of milling reagents in other areas, we believe that comparisons cannot be reliably made. While milling reagents were not shown to be acutely toxic in tailings from Island Copper and Kitsault mines, different hydrographic conditions prevailing in the different mines make effective comparison difficult.

The same commentor (244/23,38,45a,58) noted that no additional detailed toxicity information for M502 is required at this stage of the investigation because all indications are that toxicity will be markedly reduced as a result of flocculation. We agree that no additional detailed toxicity information is needed at this stage of investigation. However, M502 is a quaternary ammonium compound for which the functional group is recognized to be toxic to aquatic life. This potential has not been quantitatively characterized for this specific milling reagent. In discussing the issue with the manufacturer (Calgon 1987), we were informed that, while the flocculant was bound with suspended particulates, its bioavailability would be precluded. However, this is only assumed to be the case, with no supporting toxicity and analytical chemistry data base having been developed. We were informed that its toxicity- and chemical fate-related properties have not been characterized and it is currently marketed in Canada only. It is reassuring that the manufacturer indicates to us that desorption of the flocculent from particulate matter is not expected as a result of fluctuations in salinity, temperature, or moderate changes in pH. Additional testing of M502 should be performed before operations begin if the reagent is actually proposed for use.

U.S. Borax (244/20) indicated that hydrogen sulfide from Nokes reagent is used up during the depression of trace metals (through the formation of insoluble sulfides), and that only a minor amount is actually discharged. Therefore, no hazardous concentrations of hydrogen sulfide are expected in either the near field zone or the tailings turbidity plume. We note this comment, and have revised the text, Section 4.1.7.2 (Table 4-10) and Appendix G, Section 12 accordingly.

The EPA (261/6) expressed concern that toxicity information on the organic milling reagents is insufficient to adequately assess their reaction kinetics, chronic toxicity, and environmental persistence. Of particular concern are the quartenary ammonium salt polymers. Additional information detailing toxicity and reaction kinetics is not available. However, it is anticipated that the milling reagent

monitoring and effluent bioassay requirements of the NPDES permit will identify persistent reagents or their breakdown products and indicate whether a toxic hazard exists.

R-2.4 General Tailings Toxicity Comments

One commentor (148/4) noted a discrepancy where the Revised DEIS summary states that high metal concentrations may be a source of concern, while the BPJ states that acute toxicity is expected to be low, and requests additional documentation for overall conclusions related to metals toxicity. We believe the DEIS and BPJ were not contradictory because there is low probability of acute toxicity from heavy metals. The question regarding chronic toxicity of tailings from the proposed operation has not been completely resolved. Data from an environmental monitoring program following discharge will demonstrate whether actual impacts are occurring and if corrective actions are needed. A discussion of the monitoring program has been added to the EIS, Section 4.5.

One commentor (226/1) was concerned about the long range effects of additional radioactive material being put into southeast Alaskan waters and finely spread over the benthic community. We can assure the commentor that concerns about radioactive materials are not relevant at Quartz Hill. The greatest concern about radioactivity in geologic structures is focused on naturally occurring uranium. There are rocks at locations around the world that contain enough uranium to pose a possible health risk to aquatic organisms, if the uranium were to be mined and deposited in aquatic habitats. However, this is not the case at the proposed Quartz Hill mine site. U.S. Borax has conducted a study of uranium content in granite rocks at Quartz Hill (Sprague 1982). The results indicate that the average uranium content at Quartz Hill is 4 ppm, which approximates the worldwide average concentration of uranium in granite of 4.8 ppm. Therefore, natural erosion of Quartz Hill granite would deposit the same overall concentration of uranium in benthic communities as that occurring from the disposal of mine tailings. Since the uranium content of Quartz Hill granite is not disproportionately greater than the worldwide average concentration, then benthic organisms at the mill tailings disposal site would not be exposed to unusually high or dangerous levels of uranium.

One commentor (244/39) stated that information from the Greenex mine is not relevant to Quartz Hill tailings disposal. Because of the relative lack of in situ data developed at other mine sites worldwide, it is necessary to use whatever data are available. Strictly speaking, the Greenex situation may not be relevant to the situation at Quartz Hill, where the metals are in a carbonate matrix more favorable to leaching. Studies on metals flux in this area indicate that toxicologically significant concentrations may be reaching downfjord. Both the method of milling and the type of matrix may have contributed to this leaching. Conditions prevailing in Boca de Quadra and Smeaton Bay (e.g., sulfide matrix) may contribute to conditions far less favorable to leaching from sediment; therefore, the relevance of the Greenex mine

to Quartz Hill may be legitimately brought into question. Because of this, additional research was undertaken since the Revised DEIS. The results have been added to Appendix G, Section 12.

In response to a comment in the Revised DEIS that little information about tailings is available from similar operations, one commentor (244/42) noted that a voluminous body of information has been developed at Island Copper and other locations. We agree with the commentor that a large volume of information has been generated from other mining operations, and have revised the text in Appendix G, Section 12 to incorporate findings of other studies. However, we believe these data can not adequately address long-term effects on the Quartz Hill receiving environments. These findings may only be used with qualification and may not be considered definitive, because differences with Quartz Hill in terms of fjord hydrography and tailings composition/behavior may be significant. Findings from several additional studies have been added to Appendix G, Section 12.

The NMFS expressed concern (181/1) that a pH of 8 is not appropriate for assessment of leaching potential, especially in interstitial water. They also stated that reducing (i.e., anoxic) conditions may prevail in the middle basin of Boca de Quadra at certain times of the year. We do not agree with the comment, as a pH of 8 should be appropriate for assessment of leaching potential. Natural seawater should not fall below a pH of about 7.4, and generally will exceed 8. We believe that widespread anoxia is rare, and localized anoxic sediments are normally not encountered, although Burrell (1983) reports that the oxygenated sediment zone above the redox horizon is thin. It is noted from Appendix F that the discharge is expected to increase dissolved oxygen in bottom waters. It is therefore believed that anoxic conditions in bottom sediments should not normally occur.

Burrell (1983) reports natural cycling of such metals as manganese and molybdenum between sediment and interstitial water, but the proposed discharge is not expected to increase dissolved metal concentrations in bottom waters, especially since anoxic conditions are not expected.

R-3 WATER SUPPLY

Most of the water supply comments concerned the height of the Tunnel Creek dam, the impacts associated with the Wilson River well field, or the impacts of the Blossom River weir. These topics are discussed in Subsections R-3.1, R-3.2, and R-3.3, respectively. Subsection R-3.1 also includes a discussion of the instream flow requirements for Tunnel Creek, as they relate to the proposed water supply system's ability to supply water to the project without adversely affecting anadromous fish.

R-3.1 General Water Supply Comments

Several letters (152/7; 194/1; 262/4,7; and 266/2) discussed the various water supply alternatives, with the most emphasis being placed on a primary supply from a reservoir on Tunnel Creek. This would be supplemented by water from two potential alternative sources: a well field on the Wilson River or an infiltration bed in the streambed of

the Blossom River near its confluence with the Wilson River. The Forest Service preferred alternative for project water supply has been revised following interagency discussions and additional analysis of the alternatives. The additional analysis (Envirosphere 1987) examined four alternative dam heights (no dam, a 52-ft-high dam, an 80-ft-high dam, and a 110-ft-high dam) and included variations in pumping rates, instream flow requirements, and emergency water supply storage requirements. The purpose of the analysis was to determine the optimal dam height and need for a supplemental water source, based on economic factors, the project's water needs, and the instream flow required for anadromous fish.

The instream flow criteria utilized in the analysis were those recommended by Nadeau et al. (1985), and also suggested by the U.S. Fish and Wildlife Service (USFWS) and the NMFS. These criteria were the following:

o	July 1 - November 30	90 cfs
o	December 1 - March 31	15 cfs
o	April 1 - June 30	30 cfs

These flows would be measured approximately 0.5 miles upstream from the mouth of Tunnel Creek. This area is believed to present a velocity barrier to upstream migration of anadromous fish under certain flow conditions. The agreed upon instream flow requirement is the lesser of the natural flow and the criteria listed above. Therefore, it is assumed that when the total natural flow at the gage falls below these criteria, only the natural flow would be released. Results of the analysis have shown that a 52-ft-high dam on Tunnel Creek, supplemented by withdrawal from an infiltration bed in the Blossom River, would supply project needs as well as meet instream flow requirements for fish. This scenario would include a 2-day emergency water supply for the project. The present value for this alternative is comparable to the cost of the Tunnel Creek/Wilson River well field alternative presented in an earlier report (U.S. Borax 1985h) and included in the proposed project in the Revised DEIS.

With this new plan, the need for a well field on the Wilson River is eliminated, thus avoiding potential impacts associated with that alternative. Also, the weir has been eliminated from the preliminary design of the Blossom River intake. This avoids concerns about impediments to fish passage that might result from the weir. Additional design features of the water intake system have been submitted by U.S. Borax to the Corps of Engineers as part of its revised application for a Department of the Army Permit. It is anticipated that any other details of design will be addressed as part of the Alaska Department of Fish and Game's anadromous fish protection permit.

U.S. Borax (230/4) expressed their preference for a Blossom River supplemental water source that would avoid the need for the Wilson River well field, but that would not be fully developed until Phase II, when the project moves to full production capacity. Another commentor (197/3) preferred complete development in Phase I. The new water

supply system described above and included in the current preferred alternative includes two-phased development, with both primary and secondary sources developed in Phase I and additional pumps added in Phase II. The preferred strategy includes a 52-ft-high dam on Tunnel Creek and a supplemental water supply from an infiltration bed on the Blossom River. This system could be built for a cost comparable to earlier water supply cost estimates. Operationally, the addition of more pumps in Phase II would allow more water to be pumped from the Blossom River than during Phase I.

R-3.2 Wilson River Well Field

Several commentors (202/1; 252/10; and 261/22,23) expressed concerns about the potential environmental effects of a well field on the Wilson River, or requested clarification of whether the well field is part of the proposed project. The alternative that incorporates this well field is no longer preferred and has been replaced with a water intake system in the streambed of the Blossom River (see also Section R-3.1).

R-3.3 Blossom River Weir

Three commentors (176/6, 230/5, 252/11) questioned the adequacy of information concerning use of the pool at the mouth of the Blossom River as a supplemental water supply, or expressed concern about the protection of salmon. In the Revised DEIS, the preferred alternative had a water withdrawal system that included a weir to prevent saltwater intrusion into the water supply. As a result of potential concerns about how the weir may affect fish passage of both upstream (adults) and downstream (juveniles) fish, U.S. Borax has revised the design of the facility and eliminated the weir. Water will now be withdrawn from under the bed of the river through a system of subsurface pipes. These pipes will collect river water that has infiltrated the substrate. In this way, it will avoid any entrainment or impingement problems with fish. Any saltwater that enters the pool is expected to be minimal. By shunting this saltwater out of the water supply system during the short and relatively infrequent periods when saltwater may be present, the pumping system will maintain a supplemental freshwater supply for the project.

The intake area is utilized for upstream and downstream passage of fish. According to calculations by U.S. Borax (Reim 1987), it appears that sufficient flows will be maintained in the Blossom River for upstream and downstream fish passage (see Section 3.2.1). The intake is located downstream of most salmonid spawning and incubation areas in the Blossom River and therefore these phases of the salmonid life cycle would be unaffected. Also, it is anticipated that any effects resulting from potential withdrawals would be negated by Wilson River flows which would back up into the Blossom and by tides which periodically ($\pm$6 hr cycle) slow the outflow of the Wilson and Blossom rivers.

R-4 FISHERIES IMPACTS

This section includes responses to comments pertaining to fish and other aquatic organisms. Subsection R-4.1 addresses general comments, such as those pertaining to sport fishing and relative habitat values. Comments directly related to tailings disposal are addressed in Subsection R-4.2. Subsection R-4.3 is devoted to comments and responses concerned with mitigation and monitoring.

R-4.1 General Fisheries Comments

One commentor (261/9) wanted to review the document that indicated that herring are found to a maximum depth of 140 m (page 4-126, paragraph 3). This depth was based on personal communication with Blankenbeckler (1985), who directs herring studies in southeast Alaska. He stated that total maximum depth for herring in Alaska was 70-80 fathoms (128-146 m).

The same commentor (261/10) noted that references made to Waldichuk and Buchanan (1980) cited only part of their conclusions. We agree, and have added a more complete discussion of their conclusions to the text of the EIS, Section 4.2.2.2.

One commentor (264/3) stated that the value of the renewable fisheries that are lost due to the project must be calculated. By law, the Forest Service must assure that natural productivity of the fisheries in the project area will be maintained. Therefore, any negative impacts that occur as a result of this project will need to be mitigated. The EIS process has been used to avoid or minimize any impacts through project planning and design. For example, an extensive examination of potential project designs has been made. Part of this examination takes into account ways in which to avoid potential impacts to the environment. If an impact cannot be avoided or minimized, then other means have been described (e.g., egg boxes, spawning channels, etc.) to restore the productivity that is lost. These other means have been successfully used elsewhere to either improve or enhance productivity. Therefore, there is reason to believe that they will work, if needed, for the Quartz Hill project. The impact of the project on the value of the commercial fishery, as discussed in Section 4.3.1.2, is expected to be negligible.

One commentor (264/1,2) questioned the way in which the value of the fish resource was determined. This commentor felt that better management and climatic conditions make the averaging method of past counts unacceptable. We agree that larger escapements in the project area have generally occurred over the last 12 years. However, as a result of discussions at an interdisciplinary team meeting held January 9-11, 1984, in Ketchikan, Alaska, it was agreed that statistics for impact analysis would be based on escapements since 1974. This is still believed to be the most reasonable approach.

This commentor (264/1,2) was also concerned about the potential impacts of the project on salmon, considering that they have a specific genetic make-up that is closely attuned to the existing environment. This site specificity does occur; however, salmon have a considerable amount of resiliency, otherwise they would not have expanded their range to the many streams and stream habitats that drain into the North Pacific. The planning process for the proposed Quartz Hill Mine has been designed to examine all viable alternatives and to incorporate means to avoid or minimize potential impacts to natural stocks of salmon. These means are discussed throughout the EIS, particularly in Section 4.4.

One commentor (264/2) discussed the need to develop probabilities of the worst case impacts to fish in order to bound the underlying risk function. Although a risk analysis for impacts to fish is conceivable, the final function is subject to a wide range of interpretation and estimation. For example, the estimated impact from sediment on average salmon production (Revised DEIS, Table 5-2) presents fixed numbers as part of an impact scenario. For instance, Revised DEIS, Table 5-2 indicates a potential loss of 22,913 pink salmon adults in the given scenario. It would not be possible to detect such a difference in the total population, because the total return is estimated at 231,674 adults, ±50 percent. To overcome uncertainties in precisely defining impacts, the planning process is designed to avoid or minimize as many potential impacts as possible. This is accomplished through regulatory restrictions such as water quality standards, permit requirements such as restrictions on blasting near water bodies, and examination of project alternatives such as water supply sources that result in the least impact. Under the provisions of ANILCA, the Forest Service must assure that the natural productivity of the project area is maintained. If monitoring indicates that the project may be having a negative impact on productivity, either the source of the problem must be remedied or mitigative measures must be implemented. Potential mitigative measures for fish are described in the Final EIS, Section 4.4.

One commentor (244/13) felt it unlikely that sport fishing for chum salmon will occur in the project area. It is true that chum salmon are among the least popular salmon species with sport fishermen, primarily because they are not as readily taken on sports gear and their perceived quality as they near freshwater spawning areas appears lower than other salmon species. In the near term, it is unlikely that the project area would be utilized for sportfishing for this species. However, in other areas such as the Pacific Northwest and some areas of Alaska, sportsfishermen are developing techniques to catch this species. Although still limited, active sportfisheries do exist, particularly in fresh water. An active sportfishery may not develop anywhere in southeast Alaska in the near future. However, it is still conceivable that during the period of the mining operation, interest in catching this species with sports gear may develop.

One commentor (244/14) felt that the subjective ratings developed by Schmidt et al. (1977) of the Blossom, Keta, and Wilson Rivers fish rearing potential are outdated and should be modified by the results of more recent and extensive baseline studies. We do not feel that any

change in the EIS is needed. The Schmidt et al. reference was used only to describe a rating that was made by the Alaska Department of Fish and Game. This rating was based on factors such as summer and winter habitats and suitable access to these habitats. This rating ranked the Blossom River as number one, followed by the Keta (second) and Wilson Rivers (third). More recent information developed by VTN (1983g) is also presented in EIS Section 3.2.1. This information was based on habitat characterizations using aerial photos. Based on the total area for freshwater rearing in mainstem, side channels, and ponds, the Blossom River would rank as number one, followed by the Wilson and Keta rivers. The difference between actual measured areas for these habitat features is greater between the Blossom River (79.0 acres) and the Wilson (59.2 acres) or the Keta (49.3 acres) than between the latter two. Therefore, the ranking results are not radically different. Even with these estimates, the type of rearing area utilized varies considerably with fish species, streamflow, time of year, water quality, substrate and other attributes. Therefore, the information and rankings presented in this section are intended to provide only a relative idea of potential rearing between the sites.

One commentor (181/6) suggested that the available data were not adequate to make the statement that tanner crabs spend their entire life in Boca de Quadra (Revised DEIS, page 3-101). The comment is noted and the text has been modified accordingly.

One commentor (244/22) stated that the scenario presented for a breach of the water quality control dam was not likely to occur, based on actual experience at the Quartz Hill site. This experience comes from a natural landslide in 1978 that totally blocked Hill Creek, followed by a release of sediment and debris to the Keta River. The commentor states that this significant release of debris and sediment did not destroy incubating eggs or affect species production downstream. We agree in part with the commentor. The scenario presented in the Revised DEIS is a worst-possible case which has a very low likelihood of occurrence. The actual effects of any breaching of the dam would depend on the magnitude of the breach and the status of the receiving environment during the event. If, for example, a breach occurred when the Blossom River was at high flow, the water and sediment from a breach could be swept downstream with little or no impact on fish, whereas a breach during extreme low flow could significantly impact areas of the Blossom River. We have revised the scenario in the EIS (Section 4.2.1.2) to clarify the range of potential impacts. The facility will be designed to meet National Pollutant Discharge Evaluation System (NPDES) and Alaska Department of Environmental Conservation (ADEC) water quality standards. The dam will also meet design and operation standards of the Alaska Department of Natural Resources. These standards should assure that the dam is built and maintained under current safety specifications.

R-4.2 Tailings Disposal Impacts

The Southeast Alaska Seiners made several comments (176/1,2,3) concerning the cumulative risks of further development in the Wilson Arm drainage basin, and expressed concern that all potential impacts to

the important salmon fishery are not being taken into account. We maintain that the impact assessment focused on every feasible way that salmon could be affected by the project, including tailings disposal. Every mechanism that could possibly generate enough turbulence or force to move tailings into the part of the water column used by all life stages of salmon was investigated. Even considering the worst combination of events, tailings excursions into the upper water column would have to be very localized and brief; and no impacts to salmon can be projected. If the tailings pile higher than expected, the permit stipulations will require that the outfall be moved to protect the upper water column. The mine could be shut down for noncompliance. These factors, along with the design features that have been incorporated to prevent tailings or oil spill impacts, reduce the cumulative risk, especially to salmon, to the level of insignificance. Confining insignificant impacts to one basin is reasonable.

One commentor (181/9) stated that it was improper to say that no significant impacts would occur to the food chain from herring losses based on their known importance in other parts of Alaska (page 4-129). Based on the available data from extensive surveys in Boca de Quadra and Wilson Arm/Smeaton Bay, herring were not a major food source for important fish sampled, so no significant impacts were indicated from these data. We also originally qualified the statement by saying that, should the site-specific data not be correct, significant effects could occur if losses of herring were large. We believe the paragraph is correct as stated and have left it unchanged.

Another comment (181/11) stated that adult spot shrimp normally occur in water deeper than 100 m. The text statement in Section 4.2.2.2 has been changed to say spot shrimp are usually more abundant in water less than 150 m deep. The sampling in Boca de Quadra and Wilson Arm/Smeaton Bay was not adequate to be more definitive about depth distribution of spot shrimp. They were often collected in shrimp pots from 100 to 140 m average depths, but were rare below 200 m. Literature from studies of areas in British Columbia and Washington State suggest adults are most often caught in less than 100 m depths (Butler 1980).

One commentor (197/2) noted that disposing of tailings in Wilson Arm could result in increased production of important species by increasing the area of the more productive shallow water habitat. We have stated that a shallower basin could be more productive as suggested (Revised DEIS, page 4-146). The process of filling the basin, however, causes some negative impacts. The existing production of the shallow water benthic and epibenthic organisms could be reduced by smothering from tailings, in effect making the region less productive during the filling period. All of these factors were discussed in the Revised DEIS and considered in making the recommendation for discharge locations. The recommended discharge site is Wilson Arm/Smeaton Bay, but in a deeper region of the bay away from the estuary.

One comment (244/21) stated that available literature indicates recolonization of tailings occurs within 1 year and that the statement on page 4-89 of the Revised DEIS should be modified to indicate these results. The statement this comment relates to is not discussing

recolonization, only sediment composition. It is stated that the rate of natural sedimentation will affect the return of bottom sediment to predischarge conditions. This statement is correct and has not been changed. Biological impacts and recolonization are discussed in Section 4.2.2.2. In this section, we stated that recolonization would be rapid, but complete recovery would take longer than a year. This conclusion is also confirmed by recent data presented by Ellis and Taylor (1987) for Island Copper. As shown in Figure 4 of this citation, in all cases both number of organisms and number of taxa were less, although not always significantly less, for tailings compared to an artificial substrate up to 1 year after incubation began.

One comment (261/7) stated benthic community composition may be different on tailings than on natural substrates even after the organisms have had time to become established on undisturbed areas. The commentor states that "colonization" should not be confused with "recolonization" or restoration. Also the commentor suggested the community that reestablishes itself may be different than the pretailings discharge one. The commentor cited two articles which were examples of where communities on undisturbed tailings were different than natural substrate. We reviewed the two recommended articles. One (Kathman et al. 1984) examined Alice Arm benthic community composition in tailings affected and unaffected areas. Kathman et al. (1984) found, based on cluster analysis, the formally impacted stations to be indistinguishable from unimpacted stations 11 months after tailings discharge stopped, thus indicating similar species composition and abundance. Although some differences were noted in these studies it was apparent that most of the community was the same before and after the tailings discharge. Another recent study at Island Copper (Ellis and Taylor 1987) found that tailings and artificial substrate (similar to tailings in size composition) were colonized by similar arrays of taxa, although fewer in abundance and number of species. These results suggest that although some differences in species composition will occur, the recolonization of tailings should be similar to that prior to tailings discharge. We have modified the text, Section 4.2.2.2, in response to this comment.

R-4.3 Mitigation and Monitoring

Several commentors (252/4, 261/5, 266/1) noted that the Revised DEIS does not discuss specific mitigation measures which would be used to assure that tailings behavior and impacts in Wilson Arm will be as predicted. U.S. Borax has made a commitment to assure that monitoring will detect divergences from predicted impacts and that appropriate operational changes will be taken if necessary. Operational changes include increasing the dilution ratio at the outfall, providing a deeper outfall, and moving the outfall downfjord. More drastic measures, if necessary, include shunting the tailings to Boca de Quadra, reconsidering ocean or land disposal, and shutting down the mine. Additional discussion of mitigation measures has been added to Section 4.4 of the EIS. Monitoring is addressed in Section 4.5.

A commentor (264/2) felt that there is a need for discussion of proposed monitoring activities. A monitoring program will be developed as part of the U.S. Forest Service Special Use Permit for this project. The intent of this program will be to assure that the provisions of ANILCA are carried out (i.e., that the productivity of the fish resources in the project area are maintained). Thus, it will be the Forest Service lead responsibility to assure that the monitoring program will be sufficiently sensitive to detect any significant impacts. Discussion of the proposed monitoring program has been added to the Final EIS, Section 4.5.

Two commentors (252/13, 181/13) felt that the Revised DEIS showed an inadequate understanding of gravel cleaning and its effects, and too much reliance on gravel cleaning as a mitigation measure. We agree that gravel cleaning is not appropriate in all cases. There are certain habitats (e.g., deep pools or boulder-strewn areas) where such methods may be entirely inappropriate. Also, the natural flushing action of a stream is an appropriate cleanup mechanism if the source of the sediment can be stopped and the period of habitat recovery is reasonably short. However, we continue to believe that gravel cleaning is a viable option for use in specific habitats. Gravel cleaning is often performed only on severely impacted environments, where natural flushing action may take too long to reestablish the preexisting condition. Although negative impacts can occur from gravel cleaning, these are relatively short-term negative effects. The long-term positive effect is to accelerate the return of the system to its preexisting and, presumably, productive condition. For example, if sedimentation were found to be impacting a given reach of river, it could take years for it to recover under natural conditions. Over this period, productivity would probably decline. Gravel cleaning could accelerate the recovery. Implicit in these situations is that the source of sedimentation is eliminated or reduced to insignificant levels.

More than one method of gravel cleaning is presented in Section 4.4 of the EIS (e.g., bulldozer, hydraulic gravel cleaner, digging bucket, and a screened vibrating bucket). The method to be employed would depend on the given impact and the results of consultation with the appropriate review agencies. If gravel cleaning were found to be inappropriate in a given situation, other mitigation measures such as egg incubation boxes could be used to sustain the fish populations during the period that natural conditions are being restored. Some form of additional mitigation could be imposed to compensate for resource losses during the recovery period. It is assumed that any needed cleanup efforts will be conducted through coordination with the U.S. Forest Service and the Alaska Department of Fish and Game.

One comment (258/2) stated that procedures for reclamation must be spelled out in detail prior to granting of permits. We do not agree that any more detail is needed at this point. Reclamation will occur throughout operation and post-mining periods of the project. As described in the EIS, U.S. Borax, on behalf of Pacific Coast Molybdenum Company, has maintained and will be required to maintain a bond with the Forest Service conditioned upon compliance with reclamation

requirements. Reclamation activities are described in the EIS (Section 4.4 and Appendix A). Operational details of these activities will be incorporated into the mine development plan of operations, which must be approved by the Forest Service prior to approval to proceed.

One commentor (252/12) felt that the discussion of mitigation measures or efforts is incomplete. The commentor cited potential impacts from earthquakes, landslides, and avalanches as events that could occur in sensitive areas, thus causing extensive impacts. It is not foreseen that the project will induce any earthquakes, although naturally occurring earthquakes are possible. Landslides and avalanches could possibly be induced by project activities. Potential impacts of earthquakes, landslides, and avalanches are discussed extensively in Sections 4.1.9 and 4.2. Details of mitigation measures have been expanded in the Final EIS, Section 4.4. Specific measures described in the EIS can be taken to avoid potential impacts. This will be accomplished through location of project features (e.g., roads), design measures, and construction, operation, and reclamation practices. These measures will be regulated through provisions of the Forest Service Special Use Permit and other permits required for this project.

One commentor (262/1,2) stated that monitoring and contingency plans must be developed for detecting divergence from predicted tailings movements and any violations of water quality standards. U.S. Borax has stated (U.S. Borax 1987a) that it "is willing to commit to a monitoring program which will detect divergence from predicted tailings movements and cover the key questions of concern on tailings behavior and its effects." Borax also stated that it will "commit to a contingency plan which will identify possible operational steps that would be taken if the actual tailings behavior varies in some critical component from the modeling." These plans will be developed in consultation with the appropriate resource agencies as part of the project permitting process that will follow the Final EIS.

Two commentors (176/7, 252/15) inquired about the source of funding for mitigation measures and for monitoring the effects of mine construction and operation. The intent of the planning process has been to avoid as many impacts as possible through project design, thus decreasing the need for monitoring. It is the Forest Service responsibility under ANILCA to assure that the productivity of the project-affected area is maintained. The Forest Service will require monitoring as part of its Special Use Permit. U.S. Borax will be required to fund monitoring of the effects of construction and operation. Borax will also be required to incorporate mitigation costs into the overall project costs. The establishment of a resource advisory group (as described in EIS Section 4.5) will be part of this requirement. It is anticipated that the advisory group will meet on a regular basis to review results of project monitoring and mitigation. Response plans to address unpredictable events such as oil spills and landslides will be developed in consultation with the resource agencies. Additional information regarding mitigation measures, monitoring, and the resource advisory group has been added to the text of the Final EIS, Sections 4.4 and 4.5.

R-5 SOCIOECONOMIC IMPACTS

Numerous comments concerning socioeconomic impacts were received. Of these, many expressed support for the project because of the positive impact it would have on employment, income, and economic diversity. These comments require no response. Subsection R-5.1 responds to comments about the project's potential impact on community stability, and the factors which affect a mine shutdown decision. Subsection R-5.2 is devoted to the value of the southeast Alaska salmon fishery and the impact of marine tailings disposal on the fishing industry. Subsection R-5.3 addresses the many comments concerning the project's impact on services and facilities in Ketchikan, such as roads, boat harbors, and the ability of the city to finance additional services. General socioeconomic comments such as tax payments and Forest Service policies are addressed in Subsection R-5.4, while socioeconomic mitigation measures are addressed in Subsection R-5.5.

R-5.1 Community Stability

Three commentors (176/5, 252/7, 261/11) questioned the conclusion that Boca de Quadra tailings disposal, because it would increase the cost of Quartz Hill molybdenum by 55 cents per pound, would actually increase the likelihood of mine shutdowns and thereby reduce community stability compared to Wilson Arm disposal. One of the commentors (261/11) noted that the extra 55 cents per pound would be more likely to delay starting the project, but that the mine would remain open as long as the variable costs of production are covered. Another commentor (176/5) stated that cheaper tailings disposal in Wilson Arm could simply increase profits or lead to faster depletion of the molybdenum and earlier mine closure in the long run. The third (252/7) stated that there was not enough information to conclude there would be increased community stability with the Wilson Arm disposal option, or that the Wilson Arm option would be more cost-effective even if mitigation measures are required and included in cost estimates. We acknowledge that the primary effect of tailings disposal in Boca de Quadra would be to increase the capital cost of the project and possibly contribute to a delay in start-up. However, it would also carry with it increased operating costs in the form of both higher annual tailings disposal costs and higher interest payments associated with the added capital cost. These added costs, in conjunction with a falling market price or other factors, would contribute to a mine shutdown decision. Because there are so many factors involved in a given shutdown decision, the wording of the EIS has been revised to indicate that the stated impacts could occur rather than that they would occur.

One commentor (152/2) noted that the increased cost of tailings disposal [in Boca de Quadra] would raise the price of molybdenum to the consumer and would reduce the competitive position of the Quartz Hill project. We concur with this comment.

R-5.2 Economic Value of Fishery Resource

In related comments, it is asserted that tailings disposal in Boca de Quadra would be more responsive to socioeconomic concerns and that Borax should be forced to accept that alternative despite the added expense (206/4, 235/3), that Quartz Hill should not be developed at the expense of the existing southeast Alaska fishery (245/1, 235/2), and that the Forest Service has failed to weigh the potential cost to southeast Alaska of the destruction of the Wilson Arm fishery (252/8, C8/1). We acknowledge the economic importance of the southeast Alaska fishing industry. However, the Quartz Hill impact on the value of the commercial fishery is expected to be negligible. As pointed out in Section 4.3.1.2 of the EIS, tailings disposal in Wilson Arm might be expected to reduce the value of the multimillion dollar salmon fishery by less than $10,000 per year in the absence of any mitigation measures. This figure could overestimate the real impact, because protection of the fisheries resource is mandated by ANILCA and because mitigation measures and contingency plans have been agreed to by U.S. Borax, the Forest Service, the Alaska Department of Fish and Game, and other interested agencies (see Section 4.4). It is therefore not correct to assume that development of Quartz Hill will measurably decrease the value of the existing commercial fishing industry, or to assume that Boca de Quadra tailings disposal is more responsive to socioeconomic concerns.

R-5.3 Community Services and Facilities

A commentor (262/15) felt the Revised DEIS did not adequately portray the effects project construction and start-up would have on city and borough finances. Resource Assessment, Inc. estimated the commute option could result in "one-time capital costs of $14.5 million and an annual increase of $3.5 million in local government operating expenses." The commentor admitted these figures may be questionable but said they indicate local budgets could be significantly affected. We reviewed the referenced document and found that the cited potential expenditures are total gross expenditures and do not include potential revenues derived from the Quartz Hill project. Second, the report's estimate of project-related revenues to the city and borough are based solely on property and sales taxes. Potential user fees for services, special user fees (such as initial water and sewer hookup fees), and U.S. Borax mitigation fees and payments have not been included in these estimates, or assessed in their potential to pay for the expenditure shortfall. Third, estimates of potential costs made in the document are not well-documented, and we do not agree with some of the assumptions. Thus, we do not agree with the implication that there will be large city and borough expenditures resulting from Quartz Hill which will not be met by project-related funds and fees. The mitigation procedures and plan in Section 4.4.3.1 and Appendix I have been developed to measure and meet unforeseen project-related costs and U.S. Borax is prepared to work with local governments and agencies to alleviate such problems.

A commentor (262/18) noted the Revised DEIS discussed the additional project-related costs of maintaining 18.3 miles of city streets but did not discuss additional costs to be incurred maintaining 54 miles of state-maintained roads in the borough. The commentor felt most of the project-induced growth would occur outside Ketchikan city limits and therefore placed greater importance upon the state-maintained roads. We disagree with the opinion that most of the growth, excluding localized minesite workcamps and roads which will be developed and maintained by U.S. Borax, will occur outside the city with the preferred commuter option. As stated on page 4-210 of the Revised DEIS, we assume only 20 percent of the new project-related housing will be constructed outside the Ketchikan city limits. Although the exact distribution of newcomers cannot be precisely predicted, there is little doubt most of the growth will occur within city limits. A gravity model, used to estimate potential workers' preferred areas of residence, and the Ketchikan Gateway Borough Planning Department (Dragovich 1987) support this view. Therefore, we do not agree with the commentor's implication that major road maintenance impacts can be expected outside city limits. A conversation with a representative of the Alaska Department of Transportation (Schalep 1987) also supports this view. Discussion of this information has been added to the text in Sections 4.3.1.2, 4.3.1.4, and 4.3.1.5.

A commentor (262/19) accurately pointed out that the stated $1.61 million (1983 dollars) cost for building 230 additional boat slips is unrealistic. Further research indicated that the figure represents the costs for harbor construction only. To obtain a more accurate estimate of the costs of developing an additional harbor facility, the Ketchikan Harbormaster was contacted about the actual costs for developing Bar Harbor (containing 260 boat slips and 1,482 linear feet of open moorage) from 1978 through 1984. That project had harbor construction costs of $2.122 million, breakwater construction costs of $3.109 million, and dredging costs of $0.567 million (Ensley 1987). These costs were adjusted to 1983 dollars using the Consumer Price Index (CPI) for Seattle, which provides a higher cost estimate than the CPI for the City of Anchorage or the United States. Upland property acquisition costs could not be estimated because of exchange agreements on public property for private property, and therefore costs for on-land facilities also could not be estimated (Ensley 1987). Approximately 90 percent of the costs for construction of Bar Harbor are attributable to boat slips and 10 percent to open moorage (Ensley 1987). Conservatively assuming that all boats associated with the project-induced population will be kept in boat slips, one can extrapolate harbor costs from Bar Harbor to that resulting from the project. Dividing total estimated costs of $5.2182 million (90 percent of $5.798 million) by 260 boat slips results in a cost of $20,070 per boat slip. The pertinent text in Sections 4.3.1.2, 4.3.1.4, and 4.3.1.5 has been changed to reflect this revised cost estimate.

Finally, a commentor (262/20) stated the Tongass Narrows Crossing Benefit/Cost Study, completed in 1985, recommended the continuance of the ferry link to the airport through the year 2005, with additional

ferry capacity and terminal locations and expansion occurring as needed. This comment is noted and has been added to the text in Section 4.3.1.2.

R-5.4 General Socioeconomic Comments

One commentor (232/2) expressed concern for socioeconomic impacts in Ketchikan because the Forest Service has stated it cannot condition its record of decision on actions off the national forest. Thus, for example, the Forest Service cannot compel U.S. Borax to agree to specific mitigation measures designed to reduce socioeconomic impacts in Ketchikan. The commentor believes the Forest Service is being inconsistent because it is conditioning the record of decision on impacts to water quality and fisheries off the national forest, while refusing to do the same with reference to socioeconomic impacts. This apparent discrepancy comes about because the Forest Service is mandated by ANILCA to protect the fisheries resource, thereby extending its area of interest and jurisdiction beyond the national forest boundaries in this particular case. No similar mandate exists for socioeconomic impacts.

One commentor (258/3) suggested that the Forest Service grant a permit to U.S. Borax on condition that the mine not be developed until the molybdenum price is at least $5.00/lb (1982 dollars). This concern for long-term stability of the project is noted, but the Forest Service does not have the authority to grant such a conditional permit.

One commentor (262/16) questioned the discrepancy between U.S. Borax's estimates of its tax liability ($5.0 million) and a Forest Service estimate of state taxes ($280 to $330 thousand). In addition, one commentor stated that the State of Alaska should receive a fair price for the molybdenum extracted from the project (174/2). U.S. Borax owns the mineral rights to the proposed Quartz Hill site, and will pay taxes related to doing business in Alaska. The tax estimate has recently been revised, based on three Alaskan taxes: 1) Alaska income tax, with a rate rising to 9.4 percent of taxable income over $90,000, 2) Alaska minimum tax, which equals 18 percent of the federal minimum tax, and 3) Alaska mining license tax, with a rate rising to 7 percent of net income over $90,000. Over the initial project life of 24 years (4 years of development plus 20 years of operation), the combined total of the three taxes paid to the State of Alaska is estimated at $134 million, an average of $5.6 million per year. Due to start-up costs and other factors, taxes would begin at about $2 million in the fifth year of operation, rise to $12 million in years 14-16, and drop back to $8 million in years 17-20. EIS Section 4.3.2.1 and Appendix J have been revised to reflect this new tax estimate.

The taxes to be paid by U.S. Borax are established by law and would be applicable to any similar existing business or proposed project in Alaska. They do not represent any special tax breaks from the State. Additional state taxes will also be collected as a result of project-related activities. As stated on pages 4-238 and 4-239 of the Revised DEIS, $180,000 could be collected annually by the State in taxes and fees from the workforce (from an estimated 2,800

project-related population) Additional corporate income taxes paid by firms doing business with the Quartz Hill project were estimated (by the State) to be $100,000 per year.

The Ketchikan Gateway Borough (267/1) questioned the assumption that 80 percent of the population growth during project development and operation will take place in the City of Ketchikan. The Borough said it is not the source of that assumption, although it is cited as such. The 80 percent figure was not arrived at by averaging 70 percent and 90 percent, as suggested in the Borough's letter. It is the result of a more complex equation assuming: 1) 90 percent of new multifamily units are built in the city; 2) 81 percent of new single family units are located in the city, so that the overall city share of single family houses rises from 65 to 70 percent; and 3) the distribution of mobile and other housing units remains the same. These percentages, when applied to the number of new housing units estimated in Appendix I, Table I-1B, work out to 80 percent of the people locating in Ketchikan and 20 percent locating in the borough outside the city.

Two comments (262/5,17) were made about the demographic, services, and facilities baseline data being based upon early 1980s studies and project-induced impacts then being calculated upon those data. Because the construction schedule has been delayed and no new schedule has been set, the commentors recommended the data be reexamined once the new schedule was set to determine whether it and the projected impacts were still accurate. The commentors felt this would aid U.S. Borax and the affected agencies in reasonably responding to community needs. These comments are acknowledged and will be complied with when the new schedule is established. No revisions have been made to the EIS.

One commentor (262/13) stated that the project will be located outside existing borough boundaries and will not be subject to borough taxation. In addition, property taxes are not levied by the borough and thus will not be assessed against project-related in-migrants moving into the borough. However, new construction in Ketchikan, derived from project-related growth, will increase property tax revenues to that jurisdiction. The narrative on pages 4-209 through 4-210 and 4-227 of the Revised DEIS already discusses this point. No changes have been made to the text.

R-5.5 Socioeconomic Mitigation

Strong concern was expressed by a commentor (232/1) about the task of mitigating socioeconomic impacts to the City of Ketchikan. The commentor said the task was being made more difficult by "the lack of substantive progress in negotiations with U.S. Borax on impact mitigation" and "the U.S. Forest Service's failure to treat the socioeconomic impacts as serious[ly] as the environmental impacts." We disagree with this view. Ketchikan Gateway Borough, the Cities of Ketchikan and Saxman, and U.S. Borax have discussed and signed a Memorandum of Understanding (MOU) for mitigating future socioeconomic impacts caused by the project. This MOU was entered into upon recommendation by the U.S. Forest Service (see Appendix I). It outlines a set of procedures for estimating and mitigating impacts

under a blanket of "good faith." In addition, U.S. Borax agreed to employ a community liaison officer from the effective date of the MOU through the first 5 years of operation. Although the Revised DEIS discusses potential impacts of the project in detail and Section 4.4.3.1, Socioeconomic Mitigation Measures, provides conceptual measures for mitigating those impacts, detailed procedures and mitigative measures cannot be recommended based upon anticipated impacts. The mitigation program must remain responsive and flexible to properly respond to the degree of impacts and to unanticipated impacts. This requires being sensitive to potential impacts outlined in the MOU List of Discussion Issues and addressing each impact on a case-by-case basis. The public representatives' willingness to enter into the MOU and U.S. Borax's intention to abide by it represent a serious commitment to mitigating socioeconomic impacts caused by the Quartz Hill project. The commentor (232/3) also felt U.S. Borax should not assume that impacts will be successfully mitigated. U.S. Borax has set the goal of reasonable mitigation of project impacts. Therefore, it is not an assumption but a goal to strive for and meet.

Comments were made (262/6,14) about the emphasis placed in the Revised DEIS on the role of federal and state funding in providing the services needed by the project-induced population in-migration. The commentors stated it was unacceptable to rely upon federal and state government funding of capital projects and local operating budget increases. They suggested a negotiated settlement between U.S. Borax, local governments, and affected agencies to establish baseline levels of services, procedures for determining project-induced impacts above those baseline levels, and assigning responsibility for mitigating those impacts. Baseline data presented on pages 3-124 through 3-135 of the Revised DEIS and the discussion of potential project impacts from the preferred "commute" option on pages 4-168 through 4-212 of the Revised DEIS provide much of these requested data. Although the data require updating, as stated above, we assume they provide a majority of the baseline information needed to measure project impacts. Also, Appendix I already contains a signed MOU, as stated above, which was based upon negotiations between the potentially affected parties. Again, U.S. Borax has agreed to act in good faith to mitigate project-induced impacts and appropriate mitigative measures will be established on a case-by-case basis to produce the best results. The statements being questioned on pages 4-168 through 4-238 of the Revised DEIS present only existing federal and state funding levels of community services and facilities. U.S. Borax does not assume those funds will be solely relied upon for project mitigation. Section 4.4.3.1 has been revised to indicate that federal and state funds will be used for impact mitigation to the extent that they are available when the project is actually developed.

R-6 TRANSMISSION LINE

Several comments were received concerning the relationship of the Quartz Hill development and a transmission link to B.C. Hydro and/or the southeast Alaska intertie project, an electrical transmission project studied by the Alaska Power Authority (APA).

Three commentors (93/2, 266/4, 262/21) focused on the benefits which could be derived by Quartz Hill and other areas of southeast Alaska if the Quartz Hill electrical load helped justify construction of the intertie. These benefits included low cost power, reduction in oil spill hazard, and reduction in air and noise pollution. The Alaska Power Authority's study of the southeast Alaska intertie (APA 1987) concluded that, from an economic perspective, the three most favorable routes for development include new transmission links between the following:

1) Snettisham and Sitka via Juneau, Green's Creek Mine, Hoonah and Tenakee Springs;

2) Petersburg, Wrangell, and Ketchikan via a Tyee Lake-Swan Lake intertie; and

3) Quartz Hill and B.C. Hydro at Kitsault, B.C.

Together, these three routes make up the Power Authority's preferred expansion plan. The preferred expansion plan does not include a link between Quartz Hill and the rest of the southeast Alaska intertie (such as Swan Lake and Ketchikan), although such a link was studied and considered economically and technically feasible. The Power Authority study concluded that, while the Quartz Hill-B.C. Hydro link has the highest benefit cost ratio of any connection studied, both the Snettisham to Sitka and the Tyee-Swan Lake developments warrant implementation regardless of the status of Quartz Hill. Thus, inclusion of the Quartz Hill load does not appear to be necessary to justify development of other portions of the southeast Alaska intertie system, and the benefits of an intertied southeast Alaska electrical transmission system can be achieved without linking to Quartz Hill. On the environmental side, it is acknowledged that a transmission intertie would eliminate any impacts associated with on-site power generation.

Two commentors (261/17; 252/19a) contended that tailings disposal in Wilson Arm would eliminate the submarine route for the intertie and force location of the intertie on an overland route through wilderness and nonwilderness areas, and that the cumulative impacts of that action must be addressed in the EIS. We note the impacts the intertie could produce, and have added a discussion of cumulative impacts to Section 2.8. However, it is clear from the Power Authority's intertie study (APA 1987) that tailings disposal in Wilson Arm, while a factor in closing off submarine cable options in Wilson Arm, is not the sole reason for rejecting that option. Additionally, the commentor should be aware that there are no routes linking Quartz Hill to Swan Lake or Ketchikan (and hence the rest of the intertie), which completely avoids crossing the wilderness area, regardless of whether a submarine section in Wilson Arm is utilized.

R-7 WATER QUALITY

This section addresses those comments that concern water quality but are not directly related to tailings disposal. Many of the comments relate to clarified or updated water quality standards that apply to the project.

Two commentors (261/15, 262/9) noted that there are new EPA water quality values for zinc, or expressed concern over whether the most stringent or appropriate criteria have been applied, particularly with regard to Alaska receiving water standards. In response to these comments, one must first recognize that several of these criteria were published subsequent to release of the Revised DEIS in mid-April 1986. However, the text and tables in Chapter 4 and Appendix E have been reviewed and revised to reflect the current EPA criteria, which are also used by the State of Alaska in development of receiving water standards. The superseded criteria values and associated discussion have been deleted from Appendix E in order to avoid confusion. At the direction of the ADEC, the use of acute based criteria values were used in the modeling effort to determine mixing zones. We recognize that these acute criteria may not be the final receiving water standards that will be adopted by the state in relation to the proposed project, but believe that they are the appropriate reference standards to use in project planning.

Several comments (261/13,14; 262/8) expressed some concern over projected water quality. It was noted that, in addition to contaminants previously mentioned, cadmium and lead may exceed potential water quality standards in Beaver Creek and White Creek/Hill Creek. Concern was expressed over possible mistakes in the analysis. In response to these comments, several key points should be noted. First, in numerous early discussions with the ADEC, it was finally agreed that EPA acute values would serve as the basis for comparison in the performance of the modeling. It is recognized that ultimately these values may not serve as the actual standards, and this is noted in the text. Second, although there has been much discussion regarding mixing zones, and it appears that the falls of Beaver Creek (Boundary Falls) may serve as the logical boundary for the mixing zone on this stream, no formal agreement has yet been reached on the actual mixing zone boundaries. Third, no formal agreement has been reached on the applicable standards. Actual permit requirements must be negotiated between the appropriate agencies and Borax. Finally, Borax is on record and has committed to satisfy the water quality standards at the boundary of the mixing zone when it is formally established in the permit.

The above points, as well as inherent modeling uncertainty, have served as a part of the rationale and justification for the proposed monitoring program. It does appear that, under certain scenarios (application of chronic criteria and a falls mixing zone boundary),

cadmium and lead may exceed potential standards in addition to the other parameters mentioned in the text. The text has been revised to acknowledge this. If the monitoring does indicate a potential problem, appropriate treatment systems are available to assure compliance with the permits and water quality criteria. The design of the system cannot be provided until formal standards and mixing zones are adopted and monitoring data have been collected. The analysis has been reviewed in light of the original understandings noted above and the recently published criteria. The text has been revised where appropriate.

The EPA (261/16) expressed concern over our argument that drinking water standards were not applied because the water is not a proposed supply source for drinking water. This position appears to be in conflict with current ADEC regulations. It is now ADEC's position that the drinking water standards should be applied, at least as a starting point in negotiating the appropriate permits. This represents a shift in position from understandings previously reached with the ADEC. The text has been revised to reflect this change.

One commentor (244/15,32) was concerned about the statements on pages 4-28 and E-19 that some test results concerning acid-producing potential were questioned because samples were ore-like rather than waste rock. The commentor felt that "an in-depth understanding of the geology of the ore and waste rock . . . show that the acid-producing characteristics of samples tested are equally representative of the waste rock." It was also noted that Borax would produce a waste disposal plan that would address and minimize any unforeseen problems. In response, we feel the text is correct and is essentially supportive of the commentor's position. At the given point in time, there was a legitimate question regarding comparability of the samples to waste rock. A modifying statement has been added to the text to clarify the timing of the concern. A careful reading of the narrative on page 4-30, however, notes that concerns were further addressed by subsequent additional testing, and that adherence to the waste plan could prevent any extensive chemical or microbiological leaching from the waste rock. A detailed exposition of the comparative geology of the ore and waste rock at this point in the text is not warranted.

One commentor (262/10) felt that, although more details would be made available during the NPDES review process, it was not premature to raise concerns about discharges of chlorinated effluents into fresh and marine waters. In response, during a recent development meeting between Borax representatives and agency personnel, it was agreed that Beaver Creek housing and service area sewage effluent will be discharged to a drain field system rather than to a stream. In addition, for marine discharges, chlorination would not be considered. Although not discussed at the meeting, there are also alternative treatment technologies such as dechlorination or ozonation which can be considered. Several sections of the text have been revised to reflect these changes and considerations.

R-8 AIR QUALITY

One commentor (252/17) stated that no justification was provided within the Revised DEIS for considering the Quartz Hill project as "two distinct and separate air quality sources." In support of this position, the commentor stated that the ADEC had to make certain determinations and that the deficiency in air quality from Quartz Hill would be a NEPA violation. Subsequent consultation with ADEC and EPA representatives verified that the agencies agree the project represents two separate air quality sources. In addition, modeling demonstrates that all emissions will comply with Prevention of Significant Deterioration (PSD) requirements. Therefore, no changes have been made to the EIS regarding this issue.

One commentor (262/11) noted that PSD has not been triggered in the project area for total suspended particulate (TSP) matter. Therefore, the project is not subject to PSD increments for that pollutant. Text Section 4.1.1.2 has been revised to reflect this comment.

One commentor (262/12) pointed out that Figure 4-1 in the Revised DEIS shows an earlier proposed version of the mine area ambient air quality boundary. The final boundary was determined by the ADEC staff. We agree that the air quality boundary shown in Figure 4-1 is very slightly incorrect. The incorrectly displayed section is at the far northwest part of the site. However, as shown in Figure C-5-1, the maximum air quality impacts are modeled to occur at the far southern end of the site. The slight error in the displayed boundary therefore does not affect either the results or conclusions of the air quality analysis.

One commentor (261/18) noted an inconsistency in ADEC and EPA regulations to implement PSD. The ADEC is currently revising its air quality regulations and the new regulations will be similar to the EPA's. The EIS text accurately describes the revised ADEC regulations which will be applicable to the project.

One commentor (261/19) pointed out that the EPA has adopted new regulations for particulate matter, replacing the National Ambient Air Quality Standard (NAAQS) for total suspended particulate matter (TSP) with a standard for suspended particulate matter smaller than 10 microns (PM-10). The text of Appendix C, Section 1.2.2 has been revised to address PM-10. No new modeling is necessary since the PM-10 standards are greater than the impact values found for TSP. Emissions of fine particles are a fraction of all particles.

One commentor (261/20) requested that reference in Section 4.1.1.2 to TSP concentrations slightly less than 150 micrograms per cubic meter as insignificant should be changed. The text has been changed to reflect this comment.

One commentor (261/21) requested an evaluation of the impact of air emissions on visibility based on methods contained in the Workbook for Estimating Visibility Impairment (EPA-450/4-80-03). A visibility

analysis has been performed. No significant visibility impacts are expected. The results of the visibility impact analysis have been added to Appendix C, Section 5.5.

R-9 GENERAL COMMENTS

One commentor (197/1) took issue with the position frequently expressed in the Revised DEIS that "all actions in the Quartz Hill project area should be designed to minimize all human impact." The commentor believes the goal of permitting agencies should be to minimize negative impacts and also recognize opportunities to produce public benefits. We concur with the commentor, and believe that the EIS adequately acknowledges potential project benefits. These include income and employment benefits associated with the project.

One commentor (164/1), cognizant of rapidly changing technology and environmental laws, stated that all permits and licenses issued at this time should require a full review and compliance with laws and regulations in effect at the time production is to begin. We agree with the commentor that technology, regulations, economics, and other circumstances are constantly changing, and that regulatory agencies and project developers must be responsive to these changes. At the same time, we recognize that U.S. Borax has legally acquired property rights to develop their mining interests at the Quartz Hill site, and that they have a legal right to apply for permits now. The U.S. Forest Service and other regulatory agencies have the obligation to grant those permits at this time if U.S. Borax qualifies under current laws and regulations. In order to address possible future changes, permits are subject to annual and 5-year reviews. Based on these reviews, permits may be modified to reflect such things as new information, technological change, or new environmental regulations.

One commentor (206/2) recommended that lands not impacted by the approved project should be incorporated as part of the Misty Fiords Wilderness. The commentor felt that more land was excluded from the wilderness by Congress than was needed for the project. A request was made to include the Wilson, Blossom, and Keta rivers in the potential review and redesignation of wilderness lands. The comment raises a valid issue that will be resolved in the appropriate forum, which is the national forest planning process. Land management designations for all Tongass National Forest lands, including the Misty Fiords National Monument nonwilderness area, will be reevaluated in the development of the new Tongass National Forest Plan. Lands found suitable for wilderness will be identified in the plan and recommended by the Forest Service for designation by Congress. This planning process is currently scheduled to be completed over the next few years.

Without prejudice to the outcome of this planning process, it should be noted that redesignation of Misty Fiords National Monument nonwilderness lands during this planning cycle is not likely. The extent of this area was established in ANILCA such that mining facilities would not be visible from within the wilderness. While relatively little of the nonwilderness area would be actively used for the Quartz Hill project, the remaining nonwilderness lands can be

maintained in a pristine condition for later wilderness designation. Expansion of the wilderness area, therefore, is not likely to be actively considered until after the operational period of the mine, when the project area is reclaimed. In the interim, the nonwilderness lands will still be subject to the use limitations of the National Monument designation.

One commentor (252/18) stated that the Revised DEIS fails to set an appropriate bond. The commentor contended that the Forest Service must circulate for review and comment a study on the appropriate amount of the bond, as a supplement to the Revised DEIS. The Forest Service does not agree that the bond must be set at this time. As stated in the Revised DEIS, the Forest Service will require a bond in sufficient amount to ensure that the required reclamation is completed. Bonding requirements will be reviewed annually, or as often as needed, based on U.S. Borax's annual operating plan. U.S. Borax will be required in their annual operating plan to show their construction, maintenance, and operation plans for the period. The Forest Service will calculate bonding needs using the format prescribed in the Forest Service Manual, FSM 6506.82. The procedure outlined here is the same as that used for the bulk sample access road. For that phase of the project, the bond was calculated after issuance of the Final EIS.

One commentor (252/20) incorporated by reference their previous comments to the Forest Service on the first DEIS and to the EPA on the draft NPDES permit. We acknowledge receipt of those comments, which were responded to by the Forest Service and EPA in the Revised DEIS.

The Sierra Club Legal Defense Fund (252/1,2) contended that submarine disposal of tailings violates substantive provisions of ANILCA and the procedural provisions of both ANILCA and NEPA. Data gaps documented in the Revised DEIS are cited to substantiate their position. The missing data are unobtainable at this time. Worst case analyses and modeling were used to estimate effects. For example, see the discussion on dissolved metals in the near field in Appendix F. All activities will be conducted to minimize adverse environmental impacts. As stated in the Revised DEIS, bottom organisms and some members of commercial fish or shellfish species are projected to be lost from the mine activities. Losses are expected to be localized and insignificant within the context of the fishery resource in the study area.

The estimated losses are based on the best information available. Additional information may always improve projections, but at this time the existing information is believed by the Forest Service, and the EPA, to be adequate to support this EIS. Both the Forest Service Special Use Permit and the EPA NPDES permit will include stringent requirements for project compliance with standards that will maintain the productivity of the fishery resource.

Because absolute knowledge of exactly what will happen when the mine is in operation is not known, the Forest Service will coordinate a rigorous monitoring program of all mine activities. If it becomes apparent that unprojected significant impacts are likely to occur, mine operations will be altered, or closed down if necessary, to eliminate significant impacts.

One commentor (137/2) was concerned about finding the best possible location for a Quartz Hill townsite--taking into consideration spatial allocations, exposure to sunlight, and adequacy of waste disposal. The commentor felt the townsite could potentially become a large city and should be well planned. Townsite alternatives are analyzed in the EIS for their environmental, socioeconomic, and aesthetic effects. However, as stated in the Summary and Section 2.2.6 of the EIS, the preferred housing option for Quartz Hill employees is the "commute option." This option involves construction of a work camp to house workers at the mine and plant sites, who would live permanently in Ketchikan and would commute to the site. Because this proposed option does not include developing a townsite, the comment is not applicable at this time.

One commentor (244/10) noted that a paragraph in Section 2.5.5 describing the wharf upfjord of Wilson Arm was incorrect. That paragraph has been corrected to indicate that major filling would be required.

One commentor (252/19b) noted that the impacts of a proposed log transfer facility should be included in the EIS. The temporary log transfer facility in question was formerly part of the U.S. Borax application to the Corps of Engineers (see RDEIS Appendix P), but is no longer part of the application. U.S. Borax plans to submit a separate application to the Corps of Engineers at a later date. That application will be processed according to existing Corps/EPA procedures for log transfer and storage facilities in Alaska. Because the facility will handle only a few million board feet of timber over its six-year life, and because most of the required components will be in place as part of the Wilson Arm floating camp and wharf facility, the log transfer facility is expected to produce negligible additional impacts. A discussion of the potential impacts of the facility has been added to EIS Section 2.8, Cumulative Impacts.

R-10 EDITORIAL COMMENTS

Two commentors (181/7; 244/26-31) noted several typographical errors and inconsistencies in the text. We have made Table C-2-4 consistent with Table II-10, have removed mention of a buried pipeline, have changed the average annual precipitation to 150 inches on page A-96, have changed the reference for certain engineering data, and have changed all calculations in Appendix C to reflect corrected tractor-trailer round trip mileage and blast areas.

U.S. Borax noted (244/25) that Appendix A, Figure II-1, does not show Boca de Quadra tailings disposal as discussed in Section II. In preparing the Final EIS, we have adjusted the text so that Wilson Arm

tailings disposal is discussed in Section II as the preferred alternative and Boca de Quadra disposal is discussed in Section III with other alternatives. Figures and text now correspond.

Comment 244/11 suggested that Table 2-3, concerning costs of the water supply system should be updated with the most recent analysis given in the reference U.S. Borax and Chemical Company (1985h) by M. Schlessinger. This has been updated in the Final EIS. It now conforms to data presented in Appendix A, Table III-4.

One commentor (181/5) stated flatfish densities should be presented as kg/km^2 (page 3-89). However, the presentation is correct as shown; the VTN otter trawl data used were in catch per unit effort, with effort expressed as the distance (km) the trawl was towed. The text has been changed to explain this point.

R-11 RESPONSES TO CORPS OF ENGINEERS PUBLIC NOTICE COMMENTS

Corps of Engineers Public Notices 2-840015 dated May 1 and June 3, 1987 described the portions of the project that would require Department of the Army authorization under Section 10 of the Rivers and Harbors Act of 1988 and Section 404 of the Clean Water Act. The Public Notice dated May 1 was included in Appendix P of the Revised DEIS along with a Section 404(b)(1) Evaluation in Appendix O. That Public Notice was provided to other interested parties, and comments were requested on the adequacy of the Revised DEIS for the described work under Corps jurisdiction. In June 1987, a revised Public Notice was distributed to all parties that received the May 1 Public Notice.

In response to the Revised DEIS and Public Notices, 34 letters were addressed to the Corps. Each was given a reference number C(orps) 1 through C34. Seventeen (17) of the letters received by the Corps were exact duplications, except for the addressee, of comment letters to the Forest Service. They are not printed a second time in Appendix Q. A listing of the duplicate letters follows. In the listing, each Corps letter designation is followed by its Forest Service reference number in parentheses. Duplicate letters include the following:

C4 (212)	C20 (30)	C27 (114)
C6 (162)	C21 (21)	C28 (149)
C7 (235)	C22 (10)	C30 (246)
C13 (185)	C24 (9)	C31 (224)
C14 (63)	C25 (59)	C34 (90)
C15 (65)	C26 (122)	

Of the remaining 17 letters, 4 included comments requiring responses from the Corps. Those responses appear in the following subsections: Mitigation and Monitoring (R-11.1), Special Conditions for the Department of the Army Permit (R-11.2), and General Comments (R-11.3).

R-11.1 Mitigation and Monitoring

The USFWS made an extensive comment (C1/2) about the need for a definitive mitigation plan before a project permit is issued. Many of the concerns expressed by the USFWS were addressed during an interagency/applicant meeting held October 15 and 16, 1987, in Juneau. A summary of that meeting was distributed for participant review by letter dated November 6, 1987, and an expanded discussion of mitigation can be found in Section 4.4 of the FEIS. The EIS has been modified to include a review of the measures already taken to avoid or minimize impacts (including changes in project design or operation) and an identification, where appropriate, of which permit is associated with a given mitigative action. For unpredicted impacts, the Forest Service will take the lead to coordinate mitigation requirements with other agencies.

The Forest Service will require monitoring as part of their Special Use Permit. A multiagency response team will be part of this requirement.

The applicant will develop and submit to the U.S. Coast Guard an Operations Manual for the oil transfer facility which will incorporate 33 CFR Parts 148, 154, and 156. If approved, the Department of the Army (DA) permit would include a Special Condition that the Manual meet the requirements for pollution prevention and response and be approved by the Coast Guard prior to any marine terminal petroleum transfer operations.

The USFWS commented (C1/3) that the 404(b)(1) evaluation included in the Revised DEIS is inadequate and that the 404(b)(1) guidelines compliance determination cannot be made until specific mitigation measures, incorporating the spectrum of techniques from avoidance through compensation, are incorporated into the permitted project design. The revised 404(b)(1) evaluation, included in the FEIS as Appendix O, reflects commitments made by the applicant during the Juneau meetings with the agencies on October 15 and 16, 1987. The evaluation will not be finalized until the Record of Decision is signed by the District Engineer.

The USFWS stated (C1/4-27) that the proposed project would have significant needlessly adverse impacts on important fish, wildlife, and their habitats. They suggested certain project modifications and permit conditions before a permit is issued. The following responses pertain to these conditions or modifications.

The USFWS stated (C1/4,5) that a comprehensive Mitigation Plan should be prepared that includes specific measures to mitigate impacts due to project construction and operation. The identified components of the Mitigation Plan have been addressed, or will be addressed during the development of the applicant's monitoring and contingency plans. These plans, as part of the permitting processes following the completion of the FEIS, will define specific measures and appropriate responsible agencies.

The USFWS stated (C1/6) that a Monitoring Plan to assess the effectiveness of mitigation measures, assess the disposal of tailings, and identify unanticipated impacts should be included as part of the mitigation. The applicant committed to monitoring the tailings movements, disposal, and effects, including fines in the upper water column, density of deposited tailings, progress of deposition on the fjord bottom, biological effects, and effects on water quality in a letter to the Forest Service dated November 5, 1987 (U.S. Borax 1987b).

As part of the Mitigation Plan, the USFWS requested (C1/7) a Contingency Plan for unpredicted impacts. The applicant agreed to work out with appropriate responsible agencies a response plan to cover unpredicted events as part of the permitting processes following completion of the FEIS (U.S. Borax 1987b).

As part of the Mitigation Plan, the USFWS stated (C1/8) that a Bald Eagle Protection Plan should be prepared. It is the understanding of the Corps of Engineers that the USFWS is coordinating with the Forest Service (the land manager where the nests may be located) to address concerns under the Bald Eagle Protection Act.

The USFWS stated (C1/9) that a Spill Prevention Control and Countermeasure (SPCC) Plan should be included in the Mitigation Plan. The Forest Service requires that the applicant provide a SPCC Plan as part of their construction and operations permits, to be issued by the Forest Service prior to project implementation.

As part of the Mitigation Plan, the USFWS stated (C1/10) that a Water Quality Control Plan should be prepared. Water quality concerns will be addressed in any Section 402 (Clean Water Act) action through the National Pollutant Discharge Elimination System (NPDES) permitting for any point discharges (e.g., sedimentation ponds effluents). The State Certification of Reasonable Assurance, under Section 401 of the Act, must be issued prior to any permitted action, including the NPDES permit and the DA permit for the discharge of dredged or fill materials.

The USFWS (C1/11) stated that a Rehabilitation/Revegetation Plan should be prepared. At the October 1987 interagency meeting, the wetland losses for estuarine, muskeg, and freshwater areas and compensatory/mitigation actions, including reclamation plans identified in the EIS, were discussed. Because of the length of time of this project, there will be a reclamation team headed by the Forest Service that will implement restoration plans at the appropriate time.

To assist in preparation of the Mitigation Plan, the USFWS (C1/12) requested that the District Engineer prepare a comprehensive 404(b)(1) evaluation. A revised comprehensive 404(b)(1) evaluation is included in the FEIS. The format of the evaluation is the same as the DEIS and RDEIS.

R-11.2 Special Conditions for the Department of the Army Permit

The USFWS stated (C1/13) that the sediment control dams should be designed and maintained to treat water inflow or runoff from disturbed areas for a 10-year, 24-hour precipitation event, with a minimum detention time of 10 hours. At the agencies' meeting in October 1987, it was determined that the sedimentation ponds must be designed to detain waters to meet water quality standards on discharge, but not necessarily use the 10-hour detention time previously recommended.

The USFWS commented (C1/14) that the sediment control dams should be designed with principal and emergency spillways to safely discharge runoff from a 25-year, 24-hour precipitation event. The design of the combination principal and emergency spillways for the sediment control dams is deferred to the EPA, which is responsible for the NPDES permit for the facility, and the Alaska Department of Environmental Conservation (ADEC), which must issue a certificate of reasonable assurance that the facility as designed would meet state water quality standards.

The USFWS stated (C1/15,16) that the log rafting area should be located in at least -40 feet mean lower low water and that bark and other debris should be cleaned up periodically. The log transfer facility is no longer part of this action, but will be considered as a separate action under the joint permitting procedures of the EPA and the Corps.

The USFWS requested (C1/17,18) that a controlled blasting program should be developed and no blasting should be done at the marine terminal from May through July. A special condition would be added to the DA permit, if approved, which would read: "To minimize potential impacts to fish and wildlife during construction, a blasting plan is required. The plan shall be submitted to the District Engineer for approval prior to the sue of explosives that could affect waters of the United States. Copies of the plan shall be provided to the National Marine Fisheries Service, U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game."

The USFWS and the NMFS requested (C1/19,20; C2/3,4) no development of a Wilson River well field or associated bridges and access roads. The Wilson River well field has been deleted from the proposed project. Therefore, the proposed bridge across the Blossom River and the road from the bridge to the proposed well field will not be required.

The USFWS and the NMFS (C1/21, C2/6) stated that no water from the Blossom or Wilson rivers should be discharged into Tunnel Creek. It was agreed to at the interagency meeting in October 1987 that the release of Blossom River water down Tunnel Creek would not be prohibited. The use of Wilson River water has been deleted from the proposed action and the applicant withdrew the Alaska Department of Natural Resources (ADNR) application for a water right for a well field in the Wilson River valley (U.S. Borax 1987c).

The USFWS and the NMFS requested (C1/22, C2/5) that the Tunnel Creek storage reservoir be large enough to minimize pumping of water from other sources. The applicant has submitted to the Forest Service the Quartz Hill Water Supply Study (Envirosphere 1987), which analyzes impacts of a range of dam heights and flows. The impacts are presented in the FEIS. The information will be used to establish instream flow levels for Tunnel Creek, which will be included in a Fish Monitoring Plan to be developed by the applicant in cooperation with the Forest Service, Alaska Department of Fish and Game (ADF&G), the USFWS, and the NMFS.

The USFWS requested (C1/23) that the Tunnel Creek storage reservoir be designed to include a combination principal and emergency spillway to safely discharge runoff from a 25-year, 24-hour precipitation event. The design of the impoundment structure for the water storage on Tunnel Creek, including combination principal and emergency spillway, will be reviewed by the ADNR under the dam safety codes.

The USFWS and the NMFS recommended (C1/24, C2/7) that the storage reservoir on Tunnel Creek should be designed to maintain flows of 90 cfs from July 1 through November 30, 15 cfs from December 1 through March 31, and 30 cfs from April 1 through June 30. The new water supply study (Envirosphere 1987), provides information that will be used to discuss instream flow requirements at a later date. The appropriate resource agencies, including the ADNR, ADF&G, USFWS, and NMFS, will be parties to that discussion. A special condition would be added to the DA permit, if approved, which would read: "The water appropriation from Tunnel Creek must be in compliance with the ADNR Water Rights Permit and the ADF&G Title XVI Permit. Noncompliance will be grounds for modifying, suspending, or revoking this permit."

The USFWS stated (C1/25) that screened pumps to divert water from the Blossom River should be used to prevent impingement or entrainment of juvenile salmonids. The applicant has proposed that withdrawal from the Blossom River would be achieved by installation of a filter bed with perforated piping and a series of intake pipes leading to a pumping station on shore. Screening would not be required for the proposed mechanism.

The USFWS recommended (C1/26) that a weir or other modification of the Blossom River channel to minimize saltwater intrusion should not be used. A weir is no longer proposed for the Blossom River. According to revised information submitted to the Corps and included in the FEIS, the pumps would withdraw water from the river during periods of low flow from Tunnel Creek. When high tides create excessive salinity at the intake that could affect the metallurgical process, pumping will stop, and water will be withdrawn from the Tunnel Creek reservoir storage and/or plant site day tank.

The NMFS requested (C2/1,2) that certain special conditions be placed on the Department of Army permit, including no in-water construction from April 1 to May 31 and, after an initial use period of three years, that the 280 ft by 80 ft subtidal pad be retained without use or maintenance. The DA permit, if issued, will be conditioned to read

"That no discharge of dredged or fill material and blasting shall occur in tidal waters between April 1 and May 31." The barge area would be needed during at least two periods separated by four to six years. Since cleanup maintenance may be required before the pad can be reused, the DA permit would be conditioned to read that no storage of barges on the berth pad and no maintenance of the pad between offloadings of modules shall occur.

The NMFS commented (C2/9) that if sediment builds up in the reservoirs, threatening overflow into the stream systems, the permittee should be required to remove the sediment to an approved upland location. The recommendation is noted. The Corps has no jurisdiction for the dredging of materials from non-navigable waters for disposal at upland sites.

R-11.3 Other General Comments

The U.S. Fish and Wildlife Service (USFWS) noted (C1/1) that if substantive changes have been made to the proposed project, they will wish to review a revised public notice. Substantive changes, such as the deletion of the Wilson River well field and the new water supply system, have been made by the applicant since Public Notices 2-840015 dated May 1 and June 3, 1987. The project as now proposed will be public noticed prior to permit decisions to provide the opportunity for public and agency review and comments. The revised public notice, reflecting the deletion of the Wilson River well field and other changes, is appended to the FEIS as Appendix P.

The USFWS and the NMFS requested (C1/27, C2/8) that mill tailings be disposed into the middle basin of Boca de Quadra. The EPA has completed the Ecological Risk Assessment on the difference in marine impacts between tailings disposal in Wilson Arm/Smeaton Bay and Boca de Quadra. It is the understanding of the Corps that the NPDES permit can be issued for Wilson Arm/Smeaton Bay.

A commentor (C8/2) thought that some years ago the Corps granted a permit for developments in Boca de Quadra but was overruled and the permit issued for Smeaton Bay. The information that the Corps issued a DA permit for developments in Boca de Quadra is erroneous, as no permits were issued to U.S. Borax for that water body. Based on the District Engineer's determination that the Blossom River bulk sample access road and related facilities were in the public interest, a DA permit (071-OYD-2-820237) was issued August 30, 1982.

The State of Alaska Department of Natural Resources stated (C17/1, C17/2) that two sites eligible for the National Register of Historic Places, KET-203 and KET-038, are in the project area. KET-203 is an historic cabin ruins site and KET-038 is a reported burial box. The sites should be protected and the State Historic Preservation Office should be contacted if project work is to be conducted in the locality. The Department of the Army (DA) permit contains General Condition No. 3 that states "If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of

what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places."

Since KET-038 is a reported burial site whose location is tentatively placed at the east side of Wilson Arm near its head in Section 13, T75S, R97E, CRM, a Special Condition would be added to the DA permit which would provide that information and require that should cultural or paleontological resources be discovered as a result of the proposed activity, the Permitee must immediately notify the State Historic Preservation Officer and the District Engineer.

If the KET-203 site cannot be avoided, the State Historic Preservation Office will be contacted to begin mitigation processing.

R-12 U.S. ENVIRONMENTAL PROTECTION AGENCY RESPONSES TO COMMENTS

R-12.1 Fate and Effects of Tailings Discharge

Distribution of Suspended Solids

Several commentors (152/1,5; 244/2,8) mentioned the greater flushing potential of Smeaton Bay and/or noted that suspended tailings should not reach the upper water column and therefore should not affect fish, shellfish, or their food source. The Forest Service concurs with these comments. The Forest Service responses to comments 152/5 and 244/8 can be found in Sections 1.3 and 1.2, respectively. The EPA, however, does not concur with the apparent basis for the comments. The basis for these and additional comments (244/18,50) is alleged to be the simulations of suspended solids presented in the Revised DEIS. However, the Revised DEIS presents no estimates of suspended solids concentrations in the receiving water. The Revised DEIS does give estimates of the suspended solids expressed as a percentage of bottom concentration (Figures 4-7a, 4-7b, 4-10, 4-13, 4-14, for example) and a semiquantitative comparison is made between suspended solids observed in Rupert Inlet and simulated levels in Boca de Quadra and Wilson Arm/Smeaton Bay.

The EPA believes that the commentors have converted these percentages to concentrations in the receiving water by using the value of 20 mg/l described by Findikakis (1985) and Kowalik and Findikakis (1984). No justification for the use of this value can be found in the Revised DEIS or in the referenced supporting documents. The only supporting information for bottom concentration is that obtained in Rupert Inlet, presented in Figure 4-6 of the Revised DEIS. The Revised DEIS states that "the fines plume in Boca de Quadra can be expected to resemble those (sic) in Figure 4-6. These profiles were obtained from Rupert Inlet . . . ." Figure 4-6 shows bottom concentrations of suspended solids in excess of 600 mg/l at distances of more than 10 m from the bottom.

The EPA does not concur in the belief that 20 mg/l is an appropriate figure, and finds no real basis for it. Furthermore, there is no reason to expect that the bottom concentrations would be the same in the two estuaries.

Results of uncertainty analysis performed by the EPA in its risk assessment (EPA 1988), using some of the information given in the Revised DEIS, show that there is a high likelihood of elevated concentrations of suspended solids in the upper (20-100 m depth) water column of both Wilson Arm/Smeaton Bay and in Boca de Quadra. The basic modeling approach is based upon conserving mass and a stated justification for loading rates. The likelihood of exceeding natural conditions was estimated to be greater in Boca de Quadra than in Smeaton Bay and occurred at locations higher in the water column where population densities of planktonic life forms are greater.

Several comments (152/3; 244/4,50,56) discussed the effects of suspended solids from the discharge upon the extreme upfjord and downfjord portions of either estuary. The results of EPA's uncertainty analysis (EPA 1988) show that the potential exists for impacts upon the upfjord portions of either estuary. These impacts are higher for Wilson Arm/Smeaton Bay than for Boca de Quadra. At the downfjord end, the concentrations of suspended solids are also estimated to be higher in Wilson Arm/Smeaton Bay than in Boca de Quadra.

Settleable Solids

Two comments (152/4, 244/4) questioned the EPA's concern that Smeaton Bay will not contain the settleable solids resulting from the tailings discharge. The Forest Service and EPA have reached different conclusions on this point. The Forest Service position is explained in Section R-1.2, page R-28. The EPA's interpretation of the data leads to a conclusion that storage capacity may not be adequate. The EPA's concern is based upon the fact that the estimate of solids deposition given in the Revised DEIS comes very close to filling Smeaton Bay. The estimate is given without characterizing the uncertainty associated with the estimate. Reference material provided on the modeling (e.g., Findikakis 1985) describes a number of key assumptions that affect the tailings deposition pattern. However, no attempt has been made to evaluate the effect of these assumptions upon Wilson Arm/Smeaton Bay. Of particular importance is the effect of particle density. The volume of the pile is directly related to the density. According to information presented by Findikakis (1983), the density is a function of porosity. For mean grain diameters of the size reported in Findikakis (0-250u), this information shows that the porosity can vary between 0.40 and 0.80. This is a 100 percent change. If Quartz Hill tailings cover the full range of mean grain sizes, the margin of error in the estimate would be more than enough to result in overtopping the Smeaton Bay sill. Such is not the case for Boca de Quadra. U.S. Borax has stated, however, that the mean grain size will not cover the full range reported by Findikakis.

A number of commentors (152/2; 244/7,56) felt that the outfall could be moved down the fjord if undesirable effects were observed. Moving the outfall downfjord is feasible, but may be only partially effective in reducing undesirable effects at the latter stages of mine development. The NPDES permit will be conditioned upon a stringent monitoring program. If undesirable effects are observed or appear likely, appropriate action will be taken.

One commentor (244/47) stated that the difference in area covered by tailings disposal between Smeaton Bay and Boca de Quadra is not significant and that there should be a statement to that effect in the EIS. The difference in area covered is 60 hectares (1,660 vs. 1,600). The EPA believes that there is not sufficient information in this case to draw the conclusion that the difference in bottom habitat affected (and the resultant environmental consequences) between the two basins either is or is not environmentally significant.

R-12.2 Bioassays

One commentor (244/1) stated that sufficient information exists for the EPA to make its determination of no "unreasonable degradation" or no "irreparable harm" during monitoring and that there was no basis for statements in the EIS summary indicating a need for additional toxicity information on milling reagents and tailings.

The EPA disagrees. If significant changes are made in the reagents before the Quartz Hill Mine becomes a reality, the influence of these changes on the toxicity of the tailings will be determined by the use of bioassays before the tailings discharge is permitted. These bioassays must eventually be performed on the tailings in combination with the reagents--not just on individual reagents.

One commentor (244/24,37) expressed concern that the EPA had concluded that the bioassay tests were flawed when the EPA was involved in the planning of the studies.

The EPA agrees that the agency was consulted in the planning stages and concurred with the plan. The EPA also considered the studies to be the best possible given the circumstances, which included a very short time frame. The time frame was so short that there was some question as to whether the chronic studies could be completed in time to be included in the DEIS.

At the time, the EPA felt that the suite of test organisms used and the response measured by EVS Consultants represented a reasonable, good-faith effort on the part of U.S. Borax to provide preliminary information on some of the possible impacts of their proposed tailings discharge. This initial approach to both the acute and chronic testing is indicative of the "preliminary" nature of the information-gathering process that was initiated in support of the DEIS. It was never suggested that testing should stop after the chronic tests, with the data generated by that time being the only toxicological information

used for the Final EIS. Completion of these preliminary studies does not necessarily mean that all valid questions were addressed and that no additional information-gathering efforts would be required.

One commentor (244/40,41) did not agree that the bioassay studies were methodologically flawed. It was further stated that the studies were designed to test for chemical toxicity, not physical abrasion and smothering from suspended tailings.

To suggest that the EPA believes there were no "methodological flaws" in the bioassay studies is not entirely true. Although we have never characterized the bioassays as "flawed," the EPA believes that the usefulness of the data generated by some of the tests would have been improved had more rigorous test protocols been followed. Examples include the following: the 20-day coho-seawater challenge test was not long enough to observe possible long-term effects; the mussel larvae assay should have been conducted at the recommended ASTM temperature of 16°C, with larval mortality being reported; and more replication of the coho and amphipod bioassays was needed.

Several of the tests performed by EVS Consultants did not follow "standard" test protocols, particularly in the areas of temperature, light-dark cycling, and salinity control. Such modifications would not have been considered acceptable if the tests were being conducted solely for enforcement purposes. However, in many cases these modifications created more realistic exposure conditions (i.e., conditions more characteristic of the proposed tailings disposal sites). We believe that toxicological information collected under such conditions would actually be more useful for assessing potential environmental effects than information collected under rigid, but uncharacteristic, exposure conditions.

Initially there were little or no chemical or toxicological data available that pertained to the mixture of Quartz Hill tailings and milling reagents. Consequently, the first two questions that had to be addressed were, 1) what are the chemical characteristics of the tailings, including associated reagents? and 2) are the chemicals making up and associated with the tailings toxic to aquatic organisms representative of those inhabiting the proposed tailings discharge sites?

Consideration of the possible adverse effects of suspended solids in conjunction with toxicity was certainly needed. However, in an effort to answer one question at a time (within the time allowed) and keep the experimental design as simple as possible, it was agreed that the initial toxicity tests should be conducted in test systems where the tailings were exposed to, but not continuously suspended in, the overlying waters. The commentors are absolutely correct when they state the studies were designed to let the suspended solids settle out.

One commentor (244/59) felt that there was no significant bioaccumulation of metals from Quartz Hill tailings.

The EPA believes that regardless of the effect of gut pH on the uptake of metals from sediments, it is misleading to imply, by omission, that there is some "environmental" significance to the EVS observations that showed no significant bioaccumulation of metals during the long-term studies. These preliminary observations need to be put into proper (1983/84) perspective.

It does not follow that the "environmental conditions" are the same in both the gut and the sediment/water interface. The point the commentor makes regarding the lack of bioaccumulation of metals (based on the EVS studies) depends upon the quality of the studies conducted. The EVS studies were preliminary in nature. Bioconcentration of metals has been shown in other studies. Bioconcentration cannot be ruled out with the information available to date.

The EPA believes the bioaccumulation studies were not designed to shed light on the bioaccumulation of metals in, on, or near the tailings under natural conditions. They were primarily designed to answer preliminary questions about the direct uptake of metals from the tailings and water column. Considerations of the potentially important role of the food chain in the bioaccumulation process were not really addressed in the initial studies. The initial studies were done in an effort to answer some basic questions using fairly simple experimental designs. Consequently, even though the bioaccumulation of metals did not appear to be a major problem based on these initial studies, it is not possible to imply, much less state, that there would or would not be significant bioaccumulation of metals from the tailings under natural conditions. This is a subject area that will be addressed in the NPDES permit-regulated monitoring program.

R-12.3 Water Quality Criteria

One commentor (148/2) suggested that the use of acidification prior to testing for dissolved copper may be inappropriate and asked what the concentration would be without acidification.

The EPA notes that several assay methodologies exist for measuring metal concentrations in water. Each methodology measures a different chemical state or combination of chemical states for metals. The State of Alaska water quality standards are based on EPA's water quality criteria. These criteria are based on the Total Recoverable methodology for measuring metal concentrations in water, and acidification is a necessary step in the Total Recoverable methodology. Metal concentrations using the Total Recoverable method are directly comparable to the water quality criteria. The unacidified concentration is unknown.

One commentor (148/5) asked how many organisms will suffer from acute copper toxicity in Wilson Arm and Boca de Quadra and whether this outweighs the terrestrial impacts of using Boca de Quadra.

The number of fish and other marine organisms to be affected is unknown. However, the results of EPA's risk assessment indicate that, under the assumptions used, the risk of exceeding water quality standards is greater in Wilson Arm. The EPA also notes that the fishery is of greater value in Wilson Arm. The projected risk to the fjord and the fishery, however, does not preclude tailings disposal in Wilson Arm. Should tailings disposal in Wilson Arm lead to exceedances of water quality standards appropriate permit action will be taken. It is not appropriate to simply compare the marine resources of one basin to the terrestrial resources of another, since decisions must be based on total impacts to all resources.

A commentor (148/7,9) questioned the need for concern for acute copper toxicity on fish populations "at 11.78 ug/l when there is [sic] data to show that acute toxicity does not occur until much higher levels." The commentor further stated that regulatory standards are usually conservative and "do not necessarily reflect the concentration levels at which acute toxicity will occur."

The "need for concern" is based on the Quality Criteria for Water 1986 (EPA 1986), which documents acute sensitivities of salt water animals to copper ranging from 5.8 ug/l for the blue mussel to 600 ug/l for the green crab. Standards developed pursuant to the criteria protect the least sensitive species by protecting the most sensitive species. The final acute and chronic criterion for copper is therefore 2.9 ug/l (see response to 244/5 for an explanation of how this value was calculated). Discharge of toxics in toxic amounts is not allowed.

A question was raised about why the consideration for leaching potential was made only at pH 8 (181/1).

The EPA believes that if reducing conditions are to be expected, it should be considered whether the "worst case" scenario would produce higher concentrations of dissolved metals. Reducing conditions apparently occur and could significantly increase the availability of metals in the water column.

A commentor (244/5) stated that the "EPA must have mixed the CCC (criterion continuous concentration) and CMC (criterion maximum concentration) levels in their supporting document and have applied the chronic toxicity value of 2.9 ug cu/l as the acute toxicity (CCC)."

The EPA responds that this is not the case. The acute and chronic toxicity values for copper are identical--2.9 ug/l (EPA 1986). The 5.832 ug/l concentration referenced by the commentor is the "final acute value," not the acute criterion value. The latter figure is derived by dividing the "final acute value" by two (Stephen et al. 1985).

A concern was expressed (244/33) that it is inappropriate to consider dissolved and "Total Recoverable Concentrations" within the density current, especially in the near field, due to the fact that the density current is not an appropriate habitat for marine organisms. Further

downstream in areas removed from the active transport system where organisms could survive is the appropriate area to consider the impact of toxic components of the tailings.

The EPA disagrees. The basic premise of the discharge regulations is that toxic substances will not be discharged in toxic amounts. However, a mixing zone may be allowed as an 'allocated impact zone' where numeric water quality criteria can be exceeded as long as acutely toxic conditions are prevented. In practice, acute toxicity (criterion maximum concentration) compliance must occur within a short distance of the outfall.

One commentor (266/3) suggested that the EPA consider that the criterion acute toxicity concentration for copper may not always be toxic to the varieties of fish and marine life at a given location.

The EPA concurs and the criteria document so states. The water quality standards regulations also allow the development of site-specific criteria where the existing criteria are inapplicable.

R-12.4 Best Professional Judgment Report (Appendix S)

A comment (244/9) was received that an explanation should be made early on in the Revised DEIS that the EPA is not required to prepare an Ocean Discharge Criteria Evaluation (ODCE) as required by Section 403(c) of the Clean Water Act (CWA). The commentor believes that the Ocean Discharge Criteria (ODC) are merely used as a guideline in developing a best professional judgment (BPJ) evaluation and place no legal bounds on EPA's permit process for this project.

Notification was provided in Appendix S (p. 1) of the Revised DEIS that the EPA is not required to prepare an ODCE, but rather will use the ODC (40 CFR Part 125, Subpart M) as a means to evaluate the estuarine and marine impacts caused by discharges from the proposed project. The BPJ evaluation will provide the basis for many conditions and requirements in the NPDES permit. The legal basis for the evaluation is Section 402(a)(2) of the CWA. Further, Section 403(c) will provide the legal basis for evaluating any discharges that extend beyond the closure lines at Smeaton Bay or Boca de Quadra. A discharge to Wilson Arm is projected to eventually carry beyond the outer sill at Smeaton Bay and possibly across the closure line between Pt. Trollop and an unnamed point. In that event, the BPJ will serve as the ODCE. This explanation has also been added to the text of this EIS, Section 1.1.

One commentor (244/49) stated that the purpose of the evaluation of the application for an NPDES permit is to determine whether "unreasonable degradation" will occur with the proposed discharge. The commentor further states that in the absence of such degradation, EPA can issue the permit. EPA agrees that it will be able to develop an NPDES permit for the Wilson Arm/Smeaton Bay discharge. However, references to the terms "unreasonable degradation" and "irreparable harm" are in appropriate for EPA's analysis because they are applicable only to an Ocean Discharge Criteria Evaluation (Section 403(c) of the Clean Water

Act). The response to comment 244/9 above provides a more complete discussion of where Section 403(c) applies and where Best Professional Judgement Applies.

A comment (244/45b) claimed that the EPA has not responded to comments made by Rescan Environmental Services on the October 1985 ODCE for this project. The commentor apparently was referring to EPA's ODCE dated August 21, 1985. Rescan's comments were included with comments provided by U.S. Borax on November 1, 1985. The EPA considered all comments provided by U.S. Borax on November 1, 1985, in a written response that was provided to the U.S. Forest Service and U.S. Borax on October 30, 1986.

One commentor (244/46) clarified a point about there being no inner sill in Smeaton Bay. This clarification is noted.

A commentor (244/48) believed that the EPA needs to more clearly identify the discharge alternative for mill tailings proposed by U.S. Borax in the Introduction of the above referenced BPJ evaluation.

This clarification has been completed (see Project Overview and Scope of Evaluation, p. 4 of Appendix S).

Statements (244/51,53) were made that filling the inner basin of Boca de Quadra will change the circulation and thus the pycnocline. Any analysis of turbidity using preproject pycnocline ranges would be incorrect and misleading.

The EPA disagrees. We believe the pycnocline depth in a filled inner basin will be mainly influenced by the pycnocline depth in the remaining portion of Boca de Quadra. Therefore, a protective, dense layer of water will not be maintained over the inner basin when the coastal pycnocline falls below the Kite Island sill depth during the winter. As a result, elevated concentrations of suspended solids and turbidity will likely occur in the upper water column.

A commentor (156/14,16) noted that there is a great deal of uncertainty concerning possible changes in fjord circulation as the fjord fills with tailings.

The EPA agrees with the commentor that we cannot predict with certainty what will happen as the fjord basins fill. Whether one reaches the conclusion that the circulation will change or will not change is primarily a matter of approach to hydrography or modeling. Each has its merits, but neither is definitive. The EPA is most comfortable maintaining its interpretation that fjord circulation (flushing) will weaken as the fjord fills with tailings.

One comment (156/15) was made that summer weather patterns produce a relaxation of downwelling rather than an upwelling off the B.C. coast. The EPA notes this point.

One commentor (156/17) mentioned an earlier study which suggested that breaking lee waves are not probable in Boca de Quadra. The EPA acknowledges that they are not likely, but believes they are possible. The EPA therefore maintains its position, and no change has been made to the text.

Several comments (244/52,54,55) were made suggesting clarification or correction of points raised in the Summary for Potential Impacts of Discharged Mill Tailings (Section 5 of Appendix S).

The comments have been addressed by minor changes to the text, except for the comment regarding the sources of larvae for colonizing tailings deposits. The EPA maintains that the inner basin of Boca de Quadra will provide a significant source of larvae for colonizing tailings in the middle basin. The other discharge alternatives may have larvae available for colonizing tailings on both the upfjord and downfjord sides of the deposit, but their upfjord sources would be much less.

A comment (244/53) was made that the inner basin sill of Boca de Quadra will not be a high energy area except for the turbidity current associated with the tailings discharge.

The inner basin sill is expected to continue to be an area of more dynamic water movement even when the inner basin is filled. However, the dynamics will probably be reduced as a result of filling the inner basin.

Several comments (197/2, 208/4, 244/57) were received suggesting a more productive shallow water habitat would be created if mill tailings are disposed of in Wilson Arm. One commentor (197/2) even suggested that the point of discharge be moved farther up Wilson Arm so the tailings can be deposited in a manner that will increase the variety of habitats in the region and improve the overall ecology of Smeaton Bay.

At this time the EPA is unable to determine whether the "shallowing" of Wilson Arm and Smeaton Bay will eventually have a beneficial or adverse effect on the estuarine/marine environment. The EPA has a healthy uncertainty about colonization of tailings deposits after the discharge ceases. There is some question whether the physical or chemical nature of the tailings will inhibit colonization by species of economic or ecological importance. In fact, the colonizing community will very likely have a different composition than the existing community. Whether this is good or bad is difficult to determine at this time. The EPA does not agree, however, with the suggestion to move the point of discharge closer to the Wilson/Blossom estuary. The EPA is concerned about protecting this biologically sensitive area from the adverse effects of tailings deposition and toxicity.

A commentor (244/60) observed that water soluble hydrocarbons may occur in either Smeaton Bay or Boca de Quadra as a result of the discharge. They questioned a statement in the BPJ document that bioaccumulation of water soluble hydrocarbons may occur particularly with tailings discharge to Smeaton Bay.

The statement has been reworded to indicate that bioaccumulation may occur because both tailings and wastewater from the marine terminal would be discharged to Wilson Arm.

A commentor (244/61) found the discussion on dissolved metal concentrations and EPA's water quality criteria misleading and ignoring subsequent dilution of the tailings in the mixing chamber at the outfall structure and in the receiving water after discharge.

This entire discussion has been rewritten because too much emphasis was placed on dissolved metal concentrations. The EPA's criteria for metals are expressed as total recoverable metals, not dissolved metals.

A commentor (152/1) found no support for the EPA's conclusion that fish or their food sources will be adversely affected by suspended solids. Environmental studies performed by Bechtel and VTN indicate the limits of biologically significant penetration of sunlight in these waters was on the order of 30 m.

The EPA believes the commentor has not considered that (1) the food chain for organisms in the photic zone extends well below 30 m (e.g., Revised DEIS, Appendix S, p. 76), (2) organisms move vertically through the 30 m depth (e.g., diurnal migrations by zooplankton and herring), and (3) important biological communities are not defined by the penetration depth of sunlight (e.g., VTN 1983g, Figures 4.2-6 and 4.2-7). Considering the above, the EPA maintains that organisms of importance in the upper part of the water column (water depths less than 100 m) will be exposed to tailings in concentrations that may adversely affect them.

A commentor (252/16) questioned the Revised DEIS determination that Section 403 of the Clean Water Act (the Ocean Discharge Criteria) does not apply to the Quartz Hill project. It was believed the decision was based on an off-the-record communication with the U.S. Department of State. Further, even assuming that Boca de Quadra and Smeaton Bay are inland waters, they believe that an Ocean Discharge Criteria Evaluation is required if tailings are disposed of in Wilson Arm because suspended tailings will be transported across the outer sill of Smeaton Bay into territorial waters.

The determination that Boca de Quadra and Smeaton Bay are inland waters was made by the U.S. Department of State on March 25, 1986, and reviewed and approved by the Interagency Baseline Committee on April 24, 1986. This information is contained in letters dated March 25 and April 28, 1986, to U.S. Borax. The EPA independently confirmed this information in telecommunications with the State Department. The closure lines are the following:

Smeaton Bay: 55° 18.90'N, 130° 52.28'W (Pt. Trollop) to
55° 18.10'N, 130° 54.42'W (unnamed point).

Boca de Quadra: 55° 05.16'N, 130° 59.61'W (unnamed point) to
55° 04.05'N, 130° 59.21'W (unnamed point).

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Therefore, the fjords are inland waters shoreward of the closure lines. The commentor is correct, however, in pointing out that the Ocean Discharge Criteria apply to that portion of the Wilson Arm discharge that is transported out of Smeaton Bay if it goes beyond the closure line, which is about 4 km west of the Smeaton Bay sill. The final BPJ evaluation is also an ODCE for this portion of the discharge.

A commentor questioned the EPA's characterization of conditions in the water column as potentially toxic due to acutely toxic levels of copper. Further, the commentor stated (148/1) that the concentration of dissolved copper in the discharge is dependent upon the amount of seawater used to slurry the tailings. Therefore, the copper concentration in the mixing zone can be readily adjusted to meet required effluent limits.

The EPA maintains that acutely toxic levels of copper may occur in the water column as a result of the discharge of mill tailings from the Quartz Hill molybdenum project. The maximum dissolved concentration of copper in the discharge will be 11.87 ug/l (Revised DEIS, p. F-4), whereas the Federal Water Quality Criteria level for both acute and chronic toxicity is 2.9 ug/l. Subsequent dilution of discharged tailings in the receiving water will occur; however, a probability remains that acute/chronic level of copper will occur over a wide area in the basin receiving the discharge (EPA 1988).

A commentor (148/3) questioned why a copper level of 11.87 ug/l and a dilution of 1:1 by weight (1:2 by volume) were used in EPA's metal concentration evaluation in the BPJ. Higher dilutions in the mixing chamber are possible (e.g., 5:1 by weight) and lower copper levels of 5.6 and 4 ug/l were respectively measured in U.S. Borax's bench scale and pilot plant tests.

In completing the BPJ evaluation, the EPA used copper concentrations and dilution factors that provide an estimate of the worst case. This is consistent with analyses reported elsewhere in the EIS. The EPA acknowledges that a greater seawater to tailings ratio would produce lower dissolved copper concentrations, such as those observed in bench scale and pilot plant tests.

A commentor (148/4) noted that Appendix S (p. 79) of the Revised DEIS states that acute toxicity of discharged tailings to marine organisms is expected to be low, which does not support the concern for high metal concentrations. The commentor requests additional documentation be provided to justify the conclusions reached by the EPA.

The EPA has provided additional discussion in the BPJ (Appendix S), which more completely explains our concern for high metal concentrations (see revised Section 8). Further, the EPA has completed a risk assessment (EPA 1988) that provides probabilities on the frequency with which suspended tailings and copper concentrations would violate state water quality standards in Boca de Quadra and Wilson Arm.

A commentor (148/6) questioned whether there was any evidence to suggest significant levels of acute copper toxicity to fish outside of the mixing zones at Island Copper and Kitsault mines in British Columbia. If so, what were the dissolved copper concentrations. Further (148/8), if acute copper toxicity is a major concern in selecting a tailings disposal alternative, why hasn't the published acute toxicity data for the commercial and sports fish of concern been analyzed in the Revised DEIS and an estimate of fish mortality developed.

The EPA is unaware that mixing zones per se were established for the discharges at either Island Copper or Kitsault mines. At both mines no acute toxicity to fish has been observed in the waters that received mill tailings. At Island Copper mine, however, dissolved copper levels exceeded the EPA water quality acute criterion (2.9 ug/l) in approximately 10 percent of the marine water samples in 1985, including those samples taken 0.5 to 9 miles from the point of discharge and at water depths of 5 to 60 m (Utah Mines, Ltd. 1986). The exceedances above the criterion ranged from 3.0 to 4.1 ug/l dissolved copper. The EPA criteria for metals are specified in terms of total recoverable metal concentration, which includes both dissolved and some of the solid phase metal content. The Revised DEIS discusses projected exceedances of the total recoverable criteria on pages 4-82 and 4-83.

The Revised DEIS does not analyze the acute toxicity data for commercial and sports fish of concern probably because it is a moot question. The federal water quality criterion for copper was set to protect all aquatic life. The Revised DEIS, however, does discuss projected fish mortalities for each disposal alternative on pages 4-117 to 4-146. The EPA used these forecasts in completing the BPJ evaluation.

R-12.5 Other Comments

Several commentors (2/1; 39/1; 41/1; 71/1; 105/1; 150/1; 208/2,3,5; 230/1; 249/1; 260/1) expressed concern that the EPA had not given adequate consideration to the effects of the more costly tailings discharge alternative on mine development. Several expressed concern that the EPA had not considered the social and economic impacts of the Boca de Quadra discharge alternative.

The EPA has considered socioeconomic effects throughout the EIS process. We have conducted several economic analyses at various points in the EIS process. Initially, an economic analysis was completed that showed that on-land tailings disposal would be prohibitively expensive. We also recognize the higher capital cost associated with the Boca de Quadra discharge alternative. Based on these analyses, EPA believes that the capital cost increment posed by Boca de Quadra disposal might influence the timing of project start-up, but would have slight effect on operation of the mine once prediction has begun.

Concern was expressed by several commentors (4/1,2; 71/1; 230/3) that the difference in risk between the two fjords should be considered, especially since a significant cost difference exists between the two marine discharge alternatives.

The EPA completed an ecological risk assessment in May 1988 (EPA 1988). The risk assessment, which is based on the information presented in the Revised DEIS, was developed as a tool to aid in the evaluation and decision-making process. It showed that there were differences in the hydrodynamics and hydrography of each fjord. These differences were used in the risk assessment to differentiate the types and magnitude of environmental impacts that may occur in each basin as a result of tailings discharge. The results indicate that the risks from discharge in Wilson Arm are greater than the risks associated with discharge in Boca de Quadra. However, the projected risk does not preclude tailings disposal in Wilson Arm with appropriate monitoring of water quality.

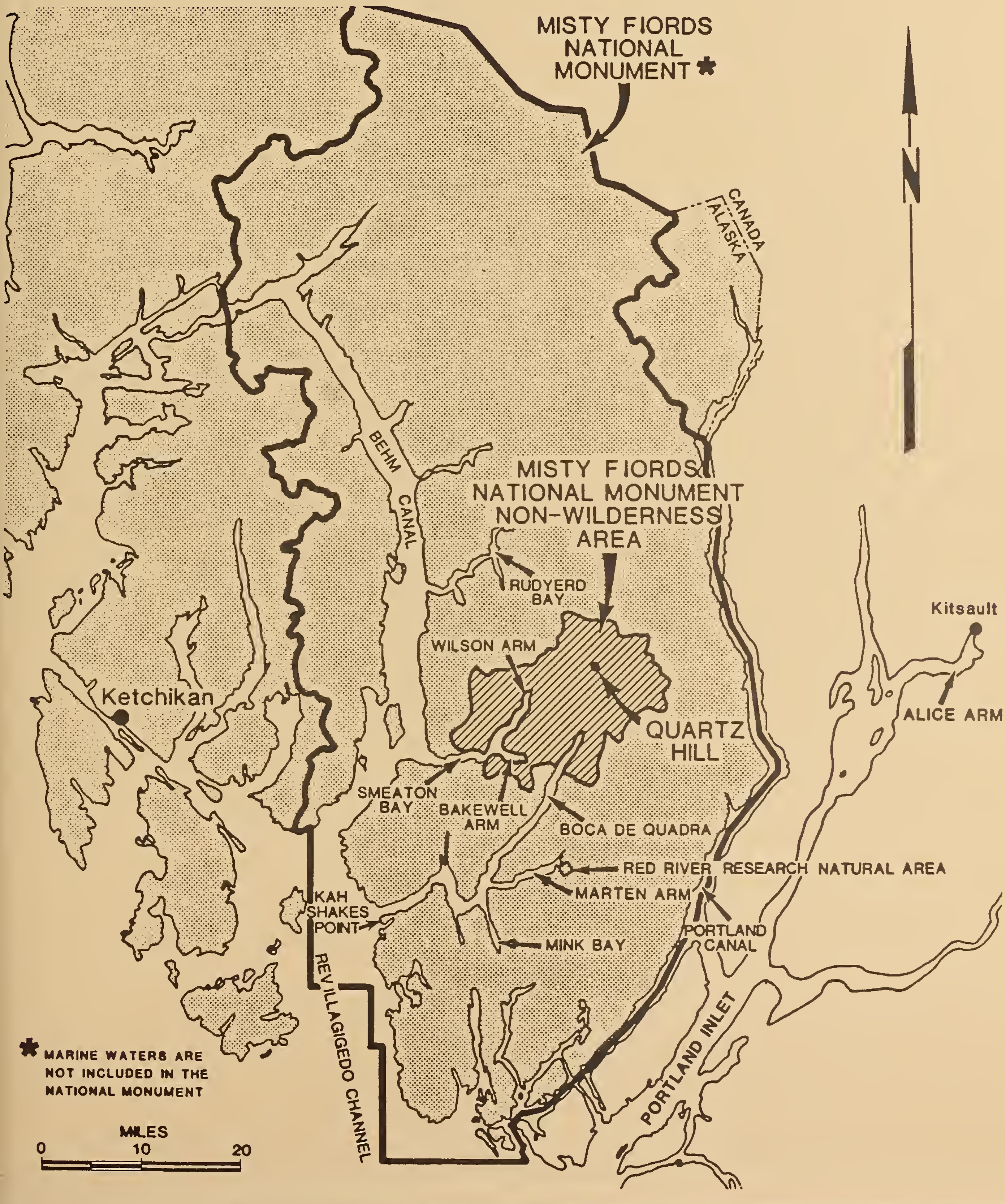
Several commentors (35/1; 57/1; 152/6; 208/1,6; 230/2) stated that the EPA has not given adequate consideration to the fact that disposal in Wilson Arm/Smeaton Bay will result in impacts being confined to a single drainage basin and it would not be necessary to have tailings disposal facilities in a designated wilderness area.

The EPA notes that if confining the mine and all of its facilities to a single drainage basin is a major goal, then other viable project component alternatives exist, such as locating all components of the project in the Keta River drainage rather than the Wilson River drainage. At any rate, the project is not without impacts to the wilderness area whether tailings are disposed in Wilson Arm/Smeaton Bay or Boca de Quadra. A Boca de Quadra discharge would involve a portal, located in the Keta River drainage, that would require less than 25 acres of land that are located in the wilderness area. As currently configured, the mine and its ancillary facilities, although not located in the wilderness area, would be heard from numerous locations within the wilderness area.

Two commentors (119/1, 151/1) felt that the EPA has not considered the potential for improved mining practices that could compensate for concerns about accumulation of tailings above 100 m in Wilson Arm/Smeaton Bay in latter years of the project.

In response, the EPA notes that no information has been found to date to indicate major changes in mining practices. The quantity of tailings is determined by the ore characteristics. Even with 100 percent extraction efficiency, this would not significantly change the quantity of tailings. EPA's permit decision must be based on currently available information and technology rather than depending on future advances in mining practices.

APPENDIX S
EPA's BEST PROFESSIONAL JUDGMENT REPORT



FINAL

A BPJ Evaluation Using the Ocean Discharge Criteria for Mill Tailings Disposal from the Proposed Quartz Hill Molybdenum Mine

EPA Work Assignment No. 8

FINAL

A BPJ EVALUATION USING THE OCEAN DISCHARGE CRITERIA FOR MILL TAILINGS DISPOSAL FROM THE PROPOSED QUARTZ HILL MOLYBDENUM MINE

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Section 1

INTRODUCTION

Purpose and Organization of Evaluation

The U. S. Environmental Protection Agency (EPA) is determining whether to issue a National Pollutant Discharge Elimination System (NPDES) permit for the discharge of mill tailings to marine waters in southeastern Alaska from the proposed Quartz Hill molybdenum mine.

On August 21, 1985, an initial evaluation was prepared in the form of a preliminary Ocean Discharge Criteria Evaluation (ODCE), which was prepared in accordance with the requirements of Section 403(c) of the Clean Water Act. An ODCE was required because both Boca de Quadra and Smeaton Bay were initially considered territorial seas by EPA. The U. S. Department of State, however, established closure lines at the entrance to Smeaton Bay and Boca de Quadra (Colson pers. comm.) in 1986. Because these fjords are now considered internal waters of the State of Alaska, EPA is not required to prepare an ODCE, but rather will use the Ocean Discharge Criteria (40 CFR Part 125, Subpart M) as a means to complete an environmental evaluation of estuarine and marine impacts using Best Professional Judgment (BPJ). In the event of tailings advection into Behm Canal, this document suffices for an ODCE of the material advected out of Smeaton Bay.

This evaluation follows a draft document entitled "A BPJ Evaluation Using the Ocean Discharge Criteria for Mill Tailings Disposal from the Proposed Quartz Hill Mine in S. E. Alaska," which was included as Appendix S in a June 1987 Revised Draft Environmental Impact Statement prepared by the U. S. Department of Agriculture, Forest Service, for this project.

On December 3, 1982, EPA excluded this mine and mill from the New Source Performance Standards (47 FR 54598) with the understanding that effluent limitations and permit conditions will be developed through the environmental review and permit processes. This evaluation is then intended to provide the basis for EPA's NPDES permit decisions.

Ocean Discharge Criteria guidelines set forth specific criteria for determining unreasonable degradation; these criteria shall be addressed prior to issuing an NPDES permit. "Unreasonable degradation of the marine environment" is defined (40 CFR 125.121[e]) as:

"(1) Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities,

"(2) Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or

"(3) Loss of aesthetic, recreational, scientific or economic values, which is unreasonable in relation to the benefit derived from the discharge."

This determination will be made based on consideration of the 10 factors contained in the quidelines (40 CFR 125.122). For purposes of this evaluation, these 10 factors have been consolidated into the following seven factors, each of which is evaluated in a separate section of this document:

1) Composition and quantities of materials discharged (Section 2).

2) Transport and persistence of materials discharged (Section 3).

3) Composition and vulnerability of the biological communities; the presence of unique or endangered species or communities; the presence of species critical to the structure of the ecosystem; the presence of spawning sites, nursery, or forage areas (Section 4 and Appendices A-E).

4) Toxicity of materials discharged and bioaccumulation in the food chain affecting plant and animal species or human health (Section 5).

5) Commercial, subsistence, and recreational fishing and shellfishing (Section 6).

6) Coastal zone management considerations and existence of special aquatic sites such as marine sanctuaries (Section 7).

7) Applicable marine water quality criteria (Section 8).

Project Overview and Scope of Evaluation

This document evaluates impacts of submarine discharge of mill tailings under an NPDES permit requested by U.S. Borax for the molybdenum mining operation at Quartz Hill in southeastern

Alaska. It also evaluates discharge of treated sanitary sewage effluent, treated washdown water, and site runoff by way of a separate marine outfall.

The project is located within Misty Fjords National Monument in a designated non-wilderness area (Figure 1-1). The project area encompasses the northern portions of Smeaton Bay and Boca de Quadra.

The project concept includes an open pit mine with ore processing facilities located in the Tunnel Creek basin. The proposed action is that tailings will be transported from Tunnel Creek by pipeline to a submarine, gravity-flow outfall in Wilson Arm of Smeaton Bay. EPA is considering an alternative action of discharge of tailings by pipeline and tunnel to a submarine, gravity-flow outfall in Boca de Quadra. Treated sanitary sewage from the Tunnel Creek and marine terminal facilities, treated equipment washdown water from the fuel oil storage area and marine terminal, and surface runoff from the marine terminal area will be discharged into Wilson Arm by way of an outfall separate from the mill tailings outfall.

Wilson Arm is a small embayment extending to the northeast at the bifurcated head of Smeaton Bay; Bakewell Arm is the other small embayment at the head of Smeaton Bay. The Wilson Arm/Smeaton Bay fjord extends from the Wilson River/Blossom River estuary westward approximately 20 km (12 mi) to Behm Canal. An underwater sill separates the 285 m (940 ft) deep Smeaton Bay basin from deeper waters in Behm Canal. Wilson Arm is approximately 160 m (540 ft) deep. The mouth of Smeaton Bay is located at approximately 55°20'N, 130°50'W.

Boca de Quadra is a fjord which extends from the Keta River estuary westward approximately 57 km (35.5 mi) to the Revillagigedo Channel. Underwater sills divide it into inner, middle, and outer basins approximately 8, 27, and 22 km (5, 17, and 13.5 mi) long and 170, 400, and 375 m (560, 1,310, and 1,230 ft) deep, respectively. The mouth of the fjord is located at approximately 55°05'N, 131°00'W.

Mill tailings discharges will average 40,000 tons/day (t/d) for the first 4-6 years, and approximately 80,000 t/d for the remaining 49-51 years of project life. This represents approximately 99 percent of the mined materials or approximately 0.84 billion m^3. The marine wastewater outfall will fluctuate in volume by season, depending on the volume of site runoff. Sewage will comprise approximately 0.033 mgd. Maximum discharge is expected to be 3.1 mgd, with a daily average of 0.24 mgd. Composition of the discharges is more fully described in Section 2.

LOCATION OF QUARTZ HILL PROJECT

FIGURE
1-1

Two tailings disposal alternatives for Boca de Quadra were initially proposed by the project applicant and are being considered as alternative actions by EPA: discharge to the middle basin only, or initial discharge to the inner basin. In the latter alternative, tailings would fill the inner basin to sill depth within 10 years and then spill over into the middle basin. The draft permit submitted by EPA on 6 August 1984 included a third alternative Boca de Quadra discharge 3.5 km (2.1 mi) downfjord of the inner sill. This location in the middle basin was selected by EPA to minimize the advection (by tidal excursion) of suspended fines over the sill into the inner basin, assuming an outfall depth of 46 m (150 ft). This objective (minimizing advection of fines into the inner basin) also can be met at locations in the middle basin nearer the inner sill if the outfall depth is deepened. Apart from the issue of advection of suspended fines over the inner basin sill, the exact location of the middle basin outfall will have little bearing on other environmental aspects of the discharges. Thus, only one middle basin discharge is addressed in this evaluation. It is assumed that the advection question can be resolved by the appropriate location and depth of the outfall.

Wilson Arm was not included as an alternative tailings discharge location in the preliminary ODCE dated 29 June 1984. On 25 January 1985, U.S. Borax submitted a revised NPDES application that requested disposal of mill tailings in Wilson Arm rather than in Boca de Quadra. Therefore, the 29 June 1984 ODCE was expanded to evaluate this disposal alternative and the wastewater discharge to Wilson Arm. This document evaluates two alternative discharge sites in Boca de Quadra (inner and middle basins) and one discharge site in Wilson Arm for mill tailings. For the purposes of this evaluation, Wilson Arm is considered a subregion of Smeaton Bay. Discharge of tailings to Wilson Arm eventually will affect all of Smeaton Bay, thus, tailings discharge to Wilson Arm is considered synonymous with discharge to Smeaton Bay.

Section 2

COMPOSITION AND QUANTITIES OF MATERIALS DISCHARGED

Summary

Mill tailing discharges will increase from a nominal 36,290 mt/d (40,000 t/d) during the first 4-6 years to 72,570 mt/d (80,000 t/d) solids on a dry weight basis during the subsequent 49-51 years of operation. The 80,000 tons of solids will be mixed with 98,000 tons of water at the time of discharge from the tailings thickener. Median grain size of the predominately quartz/feldspar tailings will be 63 microns.

Concentrations of dissolved metals in the tailings are expected to be at least one to two orders of magnitude higher than concentrations now observed in either Boca de Quadra or Smeaton Bay. Variation in the chemical composition of the solid and dissolved phases could occur over the life of the mine as different ore bodies are processed.

A number of reagents will be added during the milling process. Some of these report to the ore concentrate; others remain with the tailings; all are subject to recycling in the thickeners. As a result, an unknown quantity of the reagent load potentially will be discharged to the fjord. Milling reagents that report to the waste solids are most likely to occur in the discharge. The major organic reagent likely to be in the discharge is a quaternary ammonium salt used as a flocculant for waste rock. Only small concentrations of diesel fuel-related compounds are expected in the effluent. Reaction of Nokes reagent with water could result in the release of H_2S, which is very soluble and very toxic to marine organisms. Although it is clear that sulfide species will occur in the discharge, insufficient data exist on kinetics of reaction to determine concentration of the various species in the discharge and their biochemical oxygen demand (BOD) in the receiving water. Oxidized, less toxic species would predominate at the pH of seawater if adequate aeration occurs prior to discharge.

Small volumes of domestic sewage and groundwater (tunnel drainage) that would be discharged to Boca de Quadra with the tailings are not expected to have any effect on the fjord ecosystem. These materials would not be part of the mill tailings discharge to Smeaton Bay.

The marine terminal wastewater outfall in Smeaton Bay will discharge secondary treated sewage effluent, treated equipment washdown water, and stormwater runoff. The volume of effluent and concentration of pollutants will vary significantly as

stormwater runoff volume varies. The average daily volume of sewage and washdown water is small (approximately 39,000 gal/d) compared to the average and maximum stormwater runoff flows (0.205 mgd and 3.1 mgd, respectively). Some BOD and ammonia loading to Wilson Arm will occur as a result of the discharge. Insufficient data exist on concentrations of chlorine and dissolved petroleum hydrocarbons in the wastewater effluent and their subsequent loading to Wilson Arm.

Introduction

Molybdenum in the Quartz Hill deposit occurs as small diameter crystals (0.05-0.08 mm) of molybdenite (MoS_2) (Snook 1982, p. 288). The particles are present in quartz veins disseminated throughout an igneous intrusion. To obtain the ore, the host rock must be crushed to liberate the molybdenite crystals and flakes. The ore particles can then be physically separated from the waste rock using a flotation process. Ore is concentrated and sent to a processing plant outside of the project area.

In this section, the flotation process is briefly described along with the proposed marine outfall systems and the physical-chemical composition and quantity of wastes to be discharged. This information is needed for subsequent evaluation of the fate and effects of wastewater discharge to Smeaton Bay and tailings disposal to Boca de Quadra or Smeaton Bay.

Ore Processing

Poling (1982, pp. 65-68) generally describes the type of ore processing system planned for Quartz Hill. Following grinding, the ore enters a series of flotation cells as a slurry where the difference in surface properties of molybdenite and waste minerals is used to physically separate them. Chemicals called "collectors" are added to the mineral slurry to make the molybdenite particles hydrophobic while the waste minerals remain hydrophilic (preferentially wetted by water). Air bubbles dispersed in the flotation cells attach to the hydrophobic molybdenite particles and carry them to the surface of the cells. A stable froth column is maintained on the surface of the cells by addition of alcohol-type reagents called "frothers." The froth holds the molybdenite particles at the surface until the froth overflows the flotation cells, carrying the molybdenite to ore concentration processes.

The majority of water used in the flotation cells will be cooling water from the power plant; small quantities will come from the ore stockpile and as washdown water from the administration and service warehouse buildings. The waste rock

(tailings) pass from the bottom of the flotation cells to a tailings thickener (U. S. Borax 1984a, p. 1). The tailings thickener reclaims approximately 50 percent of the process water for recycling to the flotation cells (Rescan Environmental Services 1984, p. 38).

Tailings Slurry Quantity

For an initial 4-6 year period, the Quartz Hill Mine will process a nominal 36,290 mt/d (40,000 t/d) on a dry weight basis (U. S. Borax 1984a, p. 3). This production rate is planned to subsequently increase to a nominal rate of 72,570 mt/d (80,000 t/d). The nominal production rate represents the average design capacity of the processing facilities. Following optimization of plant operation, U. S. Borax (1984a, p. 3) expects actual daily production rates to vary above and below the nominal rate by 10-15 percent.

Since the recovered minerals represent less than 1 percent of the processed rock, the tonnage of rock mined and processed can be considered equal to the tonnage of tailings to be discharged. A discharge rate of 72,570 mt/d (80,000 t/d) solids will be used for subsequent discussion of the fate and effects of tailings discharge.

The tailings slurry prior to predilution with seawater in the mixing tank is expected to be 45 percent solids by weight (Rescan Environmental Services 1984, p. 46). At 45 percent solids, the tailings slurry will consist of 80,000 tons solids and 98,000 tons fresh water. In terms of volume, about 88,900 m^3 of freshwater and 27,500 m^3 of solids will be discharged daily, assuming a slurry specific gravity of 1.39 (U.S. Borax 1983a p. 3-8). The total mill tailings slurry discharge rate will be 1.35 m^3/sec (30.7 mgd) prior to predilution. For comparison, the mean annual discharge of the Keta River to Boca de Quadra is 23 m^3/sec (520 mgd); the combined discharge of the Blossom and Wilson Rivers to Wilson Arm is 53 m^3/sec (1,200 mgd) (Envirosphere 1984, p. 3-44).

Tailings Outfall Characteristics

Mill tailings are proposed to be discharged to Smeaton Bay (Wilson Arm) by way of an outfall separate from a marine terminal wastewater outfall discharging treated domestic sewage, treated washdown water, and treated surface runoff. Marine terminal wastewater outfall characteristics and effluent composition are discussed separately from the tailings outfall at the end of this section.

If mill tailings are discharged to Boca de Quadra, a relatively small quantity of domestic sewage from the Tunnel Creek housing facility and tunnel drainage will be included with the tailings discharge to Boca de Quadra.

Boca de Quadra

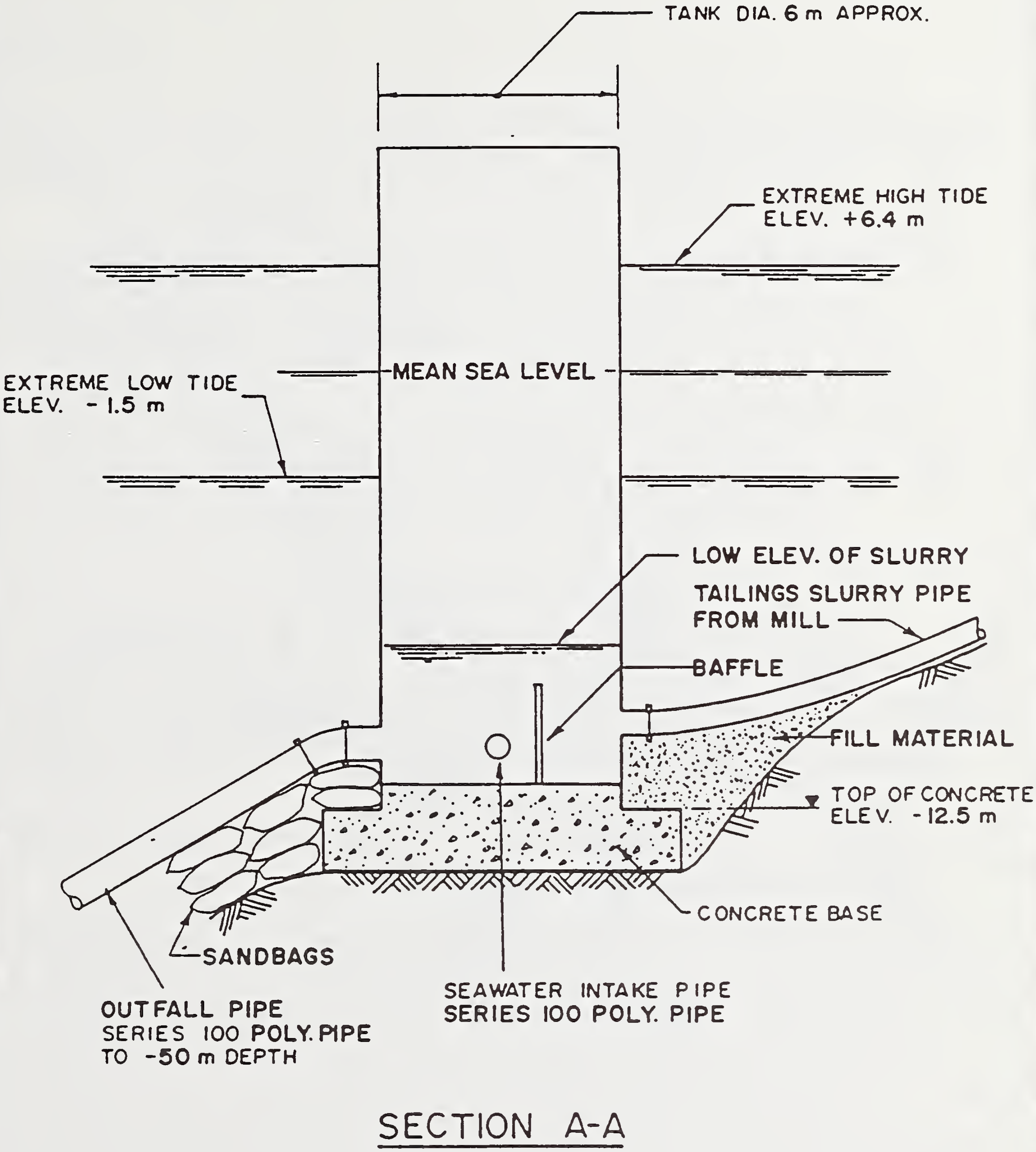
After leaving the tailings thickener, the tailings slurry will travel through a tunnel to a deaeration and mixing tank located in Boca de Quadra. The mixing tank provides for a minimum of 1:1 (by weight) predilution of tailings with seawater as well as removal of air bubbles entrained in the tailings slurry.

Removal of air bubbles should be a primary objective in design of the mixing tank. Any air bubbles discharged with the effluent will rise to the surface of the fjord, carrying discharged solids with them. This problem was observed with tailings discharge to Rupert Inlet at the Island Copper Mine on Vancouver Island, British Columbia, (Pelletier pers. comm.) and was also observed in the outfall physical model developed at the University of Iowa. To alleviate the problem at Island Copper, the mixing chamber was redesigned to allow influent tailings to enter the tank below the water line.

Two preliminary mixing tank designs were developed by U. S. Borax (1983a). Reim (pers. comm.) subsequently indicated that the design shown in Figure 2-1 is the proposed alternative.

Two alternative outfall locations in Boca de Quadra are considered in this evaluation: one located in the inner basin, and the other in the middle basin (Figure 2-2). In the initial permit application (25 April 1984), U. S. Borax proposed to discharge tailings to the inner basin (U. S. Borax 1984a, p. 10). Tailings deposition would be confined to the inner basin for the first 10 years. After the inner basin is filled (13-15 years), tailings would flow over the inner sill to the middle basin. If tailings do not flow over the sill as expected, then the outfall system would be extended to the middle basin.

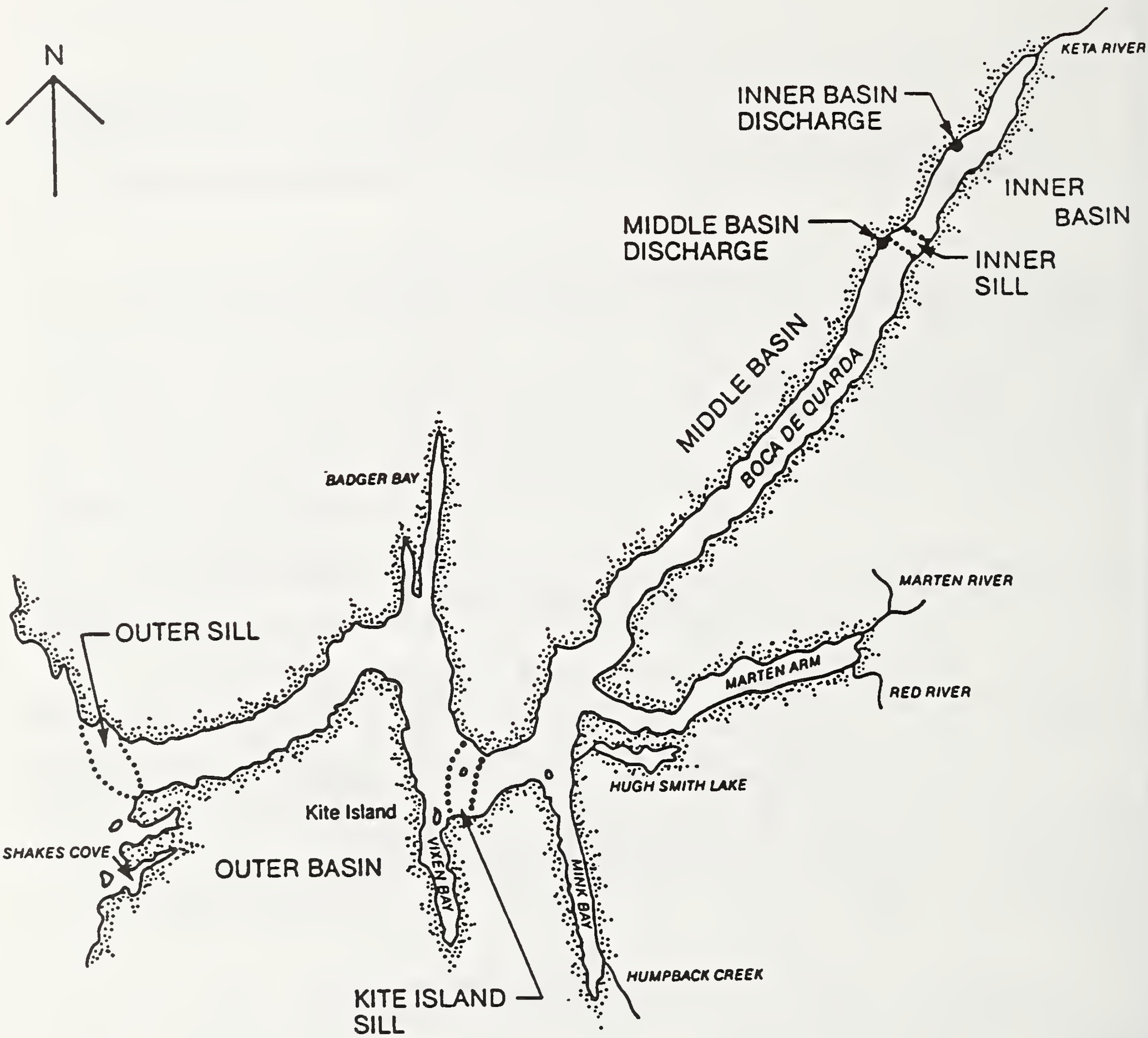
In either basin, the tailings outfall would be located at a depth of 46 m (150 ft). Middle basin discharge is proposed to occur approximately 6.7 km (22,000 ft) downfjord from the mudflat at the mouth of the Keta River (i.e., just south of the inner sill). Tailings would eventually cover the floor of the entire middle basin. Discharge to the inner basin would involve outfall placement along the western side of the inner basin. Tailings would fill the inner basin to sill depth within 10 years, and spill over into the middle basin.



PRELIMINARY DESIGN OF A SECONDARY MIXING TANK
AND TAILINGS OUTFALL

FIGURE
2-1

SOURCE: Reim, pers. comm.



ALTERNATIVE DISCHARGE LOCATIONS IN BOCA DE QUADRA

FIGURE 2-2

Wilson Arm

After leaving the tailings thickener, the mill tailings slurry will travel by pipeline to a deaeration and mixing chamber (Figure 2-1) located in Wilson Arm. The source of the process water will remain unchanged from that described above.

Discharge to Wilson Arm is proposed to occur just south of the marine terminal approximately 1.1 km (3,500 ft) downfjord from the Wilson River/Blossom River estuary mudflat (Figure 2-3) at a depth of 46 m (150 ft). If the tailings deposit and consolidate to 1.55-1.67 g/cm^3 (97-105 lb/ft^3) as predicted, the total tailings discharge to Wilson Arm will fill the entire Smeaton Bay system to 45 m (150 ft) below the sill depth at the mouth (Rescan Environmental Services 1984, pp. 61-62). The volume of the below sill basin would be reduced by more than 90 percent; the final reduction in volume will depend on the angle of repose of the tailings pile from the discharge point to the toe of the tailings pile at the mouth of Smeaton Bay.

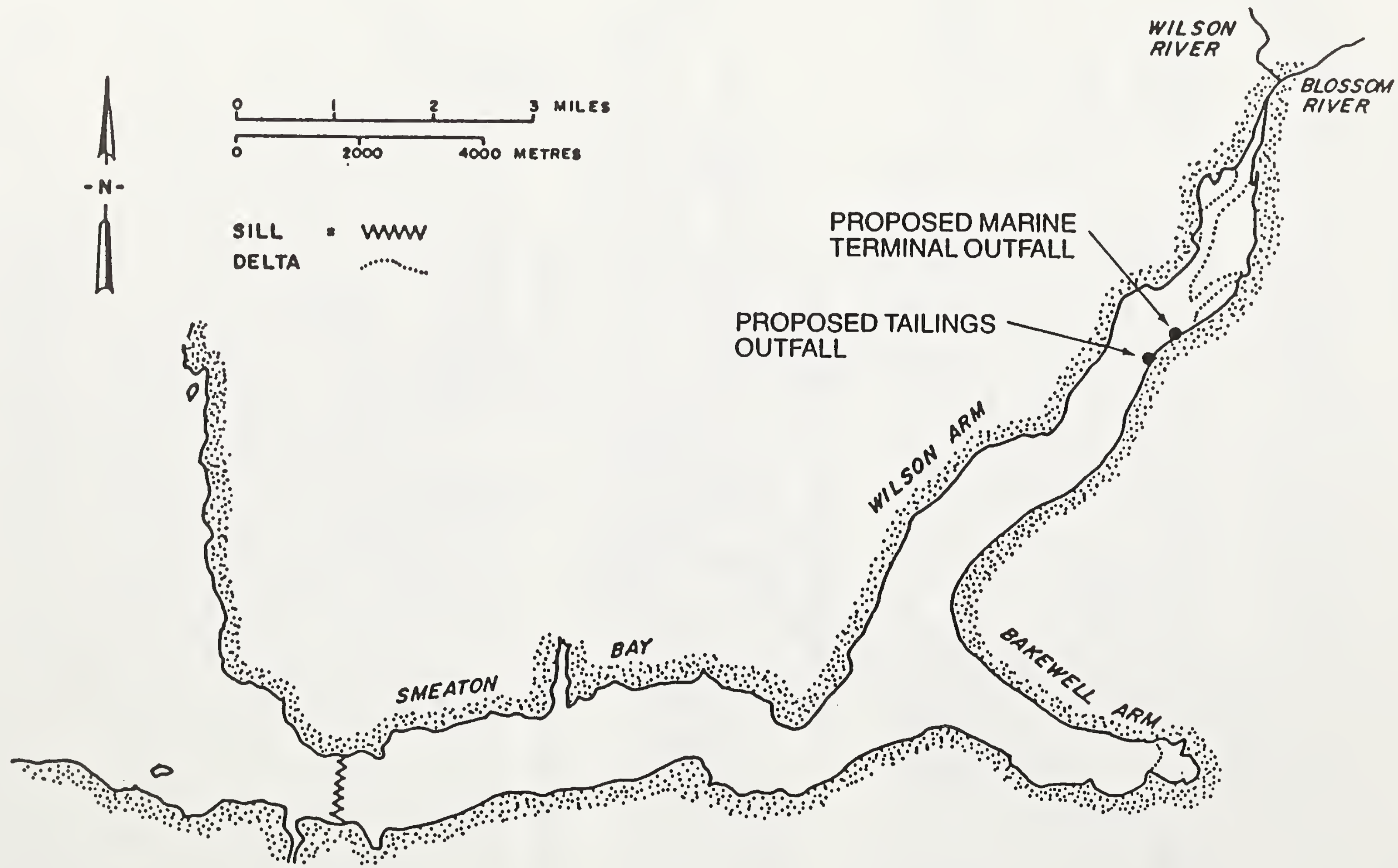
Tailings Effluent Composition

The results of bench scale analysis and pilot plant processing of the Quartz Hill bulk ore sample indicate the general characteristics of the tailing effluent. These characteristics are summarized in Table 2-1. The tailings slurry prior to predilution in the mixing tank is expected to contain 45 percent solids by weight (Rescan Envioronmental Services 1984, p. 46).

Physical Characteristics

The particle size distribution of the Quartz Hill mill tailings is presented in Figure 2-4 and compared to the size distributions of Island Copper and Kitsault molybdenum mine mill tailings. Both of these mines are located in British Columbia: Island Copper on Vancouver Island and Kitsault 40 km (24 mi) east of Quartz Hill on Alice Arm. Cumulative weight percentages are plotted on a probability scale against particle diameter on a logarithmic scale so that normal distribution will plot as a straight line. The Quartz Hill tailings are generally finer than the Kitsault tailings but coarser than the Island Copper tailings. Median grain size for Quartz Hill tailings would be 63 um, compared to 102 um for Kitsault and 32 um for Island Copper. Partical sizes 10 um and less would represent 18 percent of the Quartz Hill tailings by weight (Figure 2-4).

The density of the tailings effluent will vary as a function of solids density, solids concentration, and temperature. The density of the effluent is important in determining nearfield discharge characteristics. The discharge would too rapidly



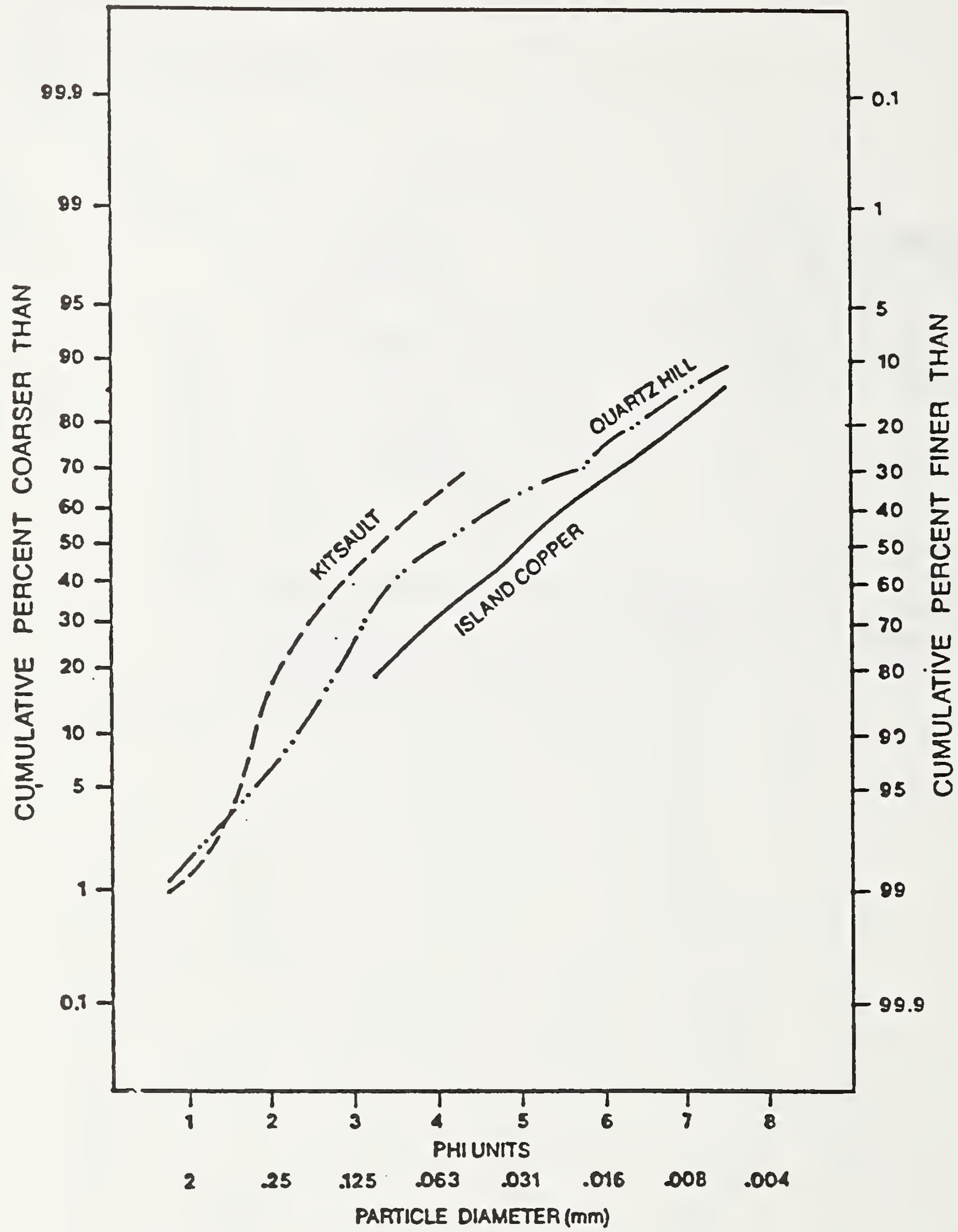
SMEATON BAY DISCHARGE LOCATIONS

FIGURE 2-3

Table 2-1. General Characteristics of the Mill Tailings Effluent

	INFORMATION SOURCE		
	a	b	c
pH	6-9	8.5	8.7 + 0.1
Summer temperature, oC	10-16	-	10.5 + 2.2[d]
Winter temperature, oC	7-10	-	-
Total dissolved solids, ppm	-	938	160 + 65
Total suspended solids, ppm	450,000-550,000	-	-
Dissolved oxygen, ppm	-	8.0	7.0 + 1.3
Total organic carbon, ppm	-	-	18.8 + 1.0
BOD_5, mg/l	15-30	-	-
Oil & grease, mg/l	<0.20	-	-

a U. S. Borax 1985.
b Bench-scale results (Rescan Environmental Services 1984, Table 4).
c Pilot plant results (ibid).
d Seasonal temp. from pilot plant not appropriate.



PARTICLE SIZE DISTRIBUTION OF QUARTZ HILL, KITSAULT, AND ISLAND COPPER TAILINGS

FIGURE 2-4

SOURCES: Paulsen pers. comm.; Burling et al., 1981 p.10; Rescan Environmental Services 1984, p.42

dilute and disperse if the tailings density approaches ambient seawater (Section 3). Quartz, the major constituent of the tailings solids, has a density of 2.65 g/cm^3 (165 lb/ft^3). Assuming a seawater density of 1.026 g/cm^3, the tailings density at discharge will be approximately as shown:

PERCENT SOLID	EFFLUENT DENSITY	DENSITY AFTER 1:1 (wt:wt) SEAWATER DILUTION	DENSITY AFTER 4:1 (wt:wt) SEAWATER DILUTION
40	1.332	1.159	1.075
45	1.389	1.180	1.083
50	1.452	1.202	1.090

Changes in temperature between 1°C and 15°C will change the tailings density only slightly (in the third decimal place). A similar effect on tailings density would be noted if 1 g/l of dissolved solids occurred in the ambient seawater used for predilution. Findikakis (1983, p. 27) assumes a tailings slurry density of 1.47 g/cm^3 prior to predilution, based on processing with seawater and 50 percent solids by weight. Burling et al. (1981, p. 37) report a predilution tailings density of 1.28 g/cm^3 at the Kitsault Mine.

Chemical Composition

The Quartz Hill mill tailings effluent will be composed of waste rock particles, water, and residual milling chemicals. Approximately 94 percent of the particles will be quartz and feldspar minerals (U. S. Borax 1984a, Table 1). U. S. Borax conducted pilot plant testing of a large bulk ore sample. The analyses of the solid and liquid fractions of the tailings from these tests are considered to be the best chemical characterization to date (Paulsen pers. comm.). Tailings were sampled 24-27 October 1983 as 24-hr composites, hourly composites, and grab samples. Although the exact number of analyses is not reported, the resulting range of concentrations during this representative time period provides a preliminary indication of chemical variability.

The concentration of potentially toxic metals in tailings solids is shown in Table 2-2 and compared to mill tailings from the Island Copper and Kitsault Mines as well as to average amounts of elements in the earth's crust. The metals concentrations of the Quartz Hill tailings are generally similar to tailings from Island Copper and Kitsault with the possible exception of a slightly higher level of arsenic.

Metals concentrations in the liquid or dissolved phase of the Quartz Hill tailings are compared in Table 2-3 to maximum dissolved metals concentrations observed in Boca de Quadra (Erickson and Stukas 1983, pp. 1-25) and in Smeaton Bay (Burrell

1983, Table 7.5). Reported concentrations for the Island Copper and Kitsault tailings are also listed. Dissolved metals probably will be present in the Quartz Hill tailings at concentrations at least one or two orders of magnitude higher than concentrations now observed in Boca de Quadra or Smeaton Bay. Rescan Environmental Services (1984, p. 44) notes that pilot plant results may more closely simulate actual operations, although bench-scale results can be regarded as more conservative estimates for the impact assessment. Relative to Island Copper tailings, the Quartz Hill mill tailings are likely to contain higher quantities of dissolved cadmium, chromium, lead, mercury, molybdenum, and zinc based on the more conservative bench-scale tests. Relative to Kitsault, dissolved cadmium, lead, nickel, and selenium may be higher in Quartz Hill mill tailings effluent. If pilot-scale results are judged more representative, then Quartz Hill effluent will be generally cleaner than effluent from the other two mines with the possible exceptions of chromium and selenium.

Substantial variation in the chemical composition of the solid and dissolved phases could occur over the life of the Quartz Hill Mine as different parts of the ore body are processed or because of adjustments or variation in the mining process. U. S. Borax (1984b, p. 8) reports, however, that the ore body is relatively uniform in nature. Some variation in the chemical composition of the tailing effluent can be expected.

A number of chemicals must be added to the milling process to control the separation of the molybdenite from the waste (gangue) minerals. The proposed reagents and their application rates are presented in Table 2-4. Frothers are used to maintain a stable layer of froth on top of the aerated flotation cell. Collectors are used to improve the separation of the naturally hydrophobic molybdenite crystals from the slurry in the flotation cell. The majority of chemicals used as frothers and collectors, therefore, will be removed with the molybdenite concentrate through each flotation step. The concentrate is sent to the thickener, then filtered, dried and packaged. At this point, the liquid extract from the thickener would be recycled into the flotation process (Envirosphere 1984, Figure II-8). The wastewater from the flotation process, however, is likely to be contaminated by an undetermined fraction of these chemicals.

Depressants, pH modifiers, and flocculants are used either to prevent other minerals from being collected, to remove other previously collected minerals, or to thicken the tailings. The majority of these chemicals, therefore, are subject to discharge unless they are consumed during the process or reclaimed at the tailings thickener where 50 percent of the water is reclaimed and recycled to the process.

Table 2-2. Mill Tailings Solid Phase Composition (mg/kg)

	CRUST[a]	QUARTZ HILL b	QUARTZ HILL c	ISLAND COPPER[d]	KITSAULT[d]
Antimony	1	--	<0.002	--	--
Arsenic	5	10.9		5	9.3
Cadmium	0.15	2.4		3	12.9
Chromium	200	10		--	--
Cobalt	23	--	3.3	--	--
Copper	70	69		700	56.1
Lead	16	47		20	195
Manganese	1,000	462		650	365
Mercury	0.5	<0.05		0.03	<1.15
Molybdenum	15	120		40	165
Nickel	80	17.7		20	4.4
Selenium	0.09	0.10		--	--
Silver	0.1	0.13		--	--
Vanadium	150	--	17.6	--	--
Zinc	132	46		80	420

a CRC 1971, p. F-163.
b Envirosphere 1984, p. AII-39.
c U. S. Borax 1984a, Table 2.
d U. S. Borax 1983a, pp. E-13 and E-18.
-- Not available.

Table 2-3. Mill Tailings Liquid Phase Composition[a]

	BOCA DE QUADRA[b]	SMEATON BAY[c]	QUARTZ HILL d	QUARTZ HILL e	ISLAND COPPER f	ISLAND COPPER g	KITSAULT[f]
Arsenic	1.93	--	6.8	1.9	74	55	120
Cadmium	0.064	0.109	15	0.1	0.2	3.9	8
Chromium	--	--	34	6	1.4	4.8	--
Copper	0.39	0.49	5.6	4	15	14	85
Lead	0.016	--	120	1.1	4.2	10	18
Mercury	0.0052	--	1.2	0.5	0.2	0.1	2.4
Molybdenum	10.5	21.4	500	474	249	300	4,300
Nickel	0.35	0.51	210	9	--	4.6	70
Selenium	--	--	6.6	0.5	--	--	<0.01
Silver	--	--	7	0.2	--	--	--
Zinc	0.637	--	77	6	48	16	181

a Concentration in ppb (ug/l).
b Ambient concentrations (Erickson and Stukas 1983, pp. 1-25).
c Ambient concentrations (Burrell 1983, Table 7.5).
d Bench scale averages (Rescan Environmental Services 1984, Table 4) obtained from cores across the ore-body; therefore, these concentrations are probably representative of a wider variety of ore-type. Measurements were made prior to 2:1 dilution with seawater.
e Pilot plant averages (Rescan Environmental Services 1984, Table 4) relatively fresh (i.e., unoxidized) bulk ore sample that should more closely simulate actual plant scale operations. Measurements were made prior to 2:1 dilution with seawater.
f U. S. Borax 1983a, pp. E-14 and E-19.
g Utah Mines LTD. (1986, Vol. 1, p. 11). Maximum concentration measured in effluent during 1985 prior to dilution in secondary mixing tank shown in Figure 2-1.

It appears, therefore, that some of the milling reagents are not likely to occur in large quantities in effluent while others are likely to be. The fate of milling reagents in the flotation system is poorly understood (Davis et al. 1976, p. 1,308; Poling pers. comm.), but it is certain that some reagents will occur in the discharge. The COD of molybdenum mill tailings is reported to range as high as 91.3 mg/l (Davis et al. 1976, Table 3). Table 2-1 indicates total organic carbon of about 19 mg/l, based on pilot plant results. Rescan Environmental Services (1984, p. 44) estimated that half of the reagent load will probably be incorporated into the molybdenite concentrate. Of the other half discharged with the tailings, 50 percent will be adsorbed on particle surfaces and 50 percent will be in a dissolved phase.

It is important to understand the forms of the milling reagents that could or will enter the marine environment and their eventual fate. Dissolution of the inorganic constituents (lime and sodium silicate) should have no impact on the highly buffered marine environment. However, it is possible that large amounts of some of the organic material will be discharged, and these compounds need to be studied because little is known about their associations and diagenesis. Some of the "older" reagents have not undergone bioassay testing. Table 2-5 lists the reagents which report to the tailings in probable descending order of daily mass loading to the environment. Even though fuel oil reports to the ore concentrate, it also is included in Table 2-5 because loading data are available. Order is based on the proposed application rates (Table 2-4). Alternative reagents are noted; thereby indicating alternative loading rates.

The largest single input is from M-502; a quaternary ammonium salt polymer of high molecular weight (1-3 million). Its alternate, SF330 (M.W. 100,000-500,000), is a similar compound. The specific nature of the organic moieties of these compounds is presently unknown. These reagents are cationic polymers that act as flocculants for particles not floated off in the frothing process. Over 80 percent of these reagents should be associated with solids in the discharge (Carlson pers. comm.). The unassociated component is very soluble and should have a high degree of mobility in the marine environment. The application rate for M-502 may be less than that noted for the pilot plant (Poling 1984, p. 7), thus, the loading value in Table 2-5 may be conservative.

Fate of either of these two compounds is of added importance because of their cationic nature. Average 96 hr LC50 values of 0.22-50 mg/l have been reported for a common quaternary ammonium salt (ditallow dimethyl ammonium chloride) tested on oyster embryos, shrimp, crab, and juvenile fish in filtered seawater (Lewis and Wee 1983, p. 111). LC50 values during discharge of mine tailings should be considerably higher because of adsorption to suspended solids. Lewis and Wee (1983) reported that average

Table 2-4. Proposed Milling Reagents and Application Rates[a]

REAGENT	DESCRIPTION	USE	APPLICATION (lb/t OF ORE)
Dowfroth 250	Tri- & tetrapropylene glycol methyl ether	Frother	0.007[b]
or			
ALFOL 6	1-tetradecanol	Substitute frother	0.045[b]
MIBC	Methyl isobutyl carbinol	Frother	0.160[b]
Fuel oil	No. 2 diesel	Molybdenite collector	0.634
Stepanflote 85L	Sodium lauryl trioxy-ethylene sulfate	Frother/dispersant for the collector	0.011
Lime	Calcium oxide	pH modifier	0.134
Sodium silicate	SiO_2 and Na_2O	Gangue depressant	0.063
or			
CMC-7	Sodium carboxy-methyl cellulose	Substitute gangue depressant	0.045[b]
Nokes reagent	45% phosphorus penta-sulfide and 56.6% sodium hydroxide	Cu, Pb, and Fe depressant	0.054
M-502	Both are quaternary ammonium salt polymers	Flocculant	0.199
or			
SF330		Substitute flocculant	0.01[b]
Areodri 100	Dicarboxylic sulfonate	Surfactant drying agent	0.0002[b]

[a] U. S. Borax 1984c, Tables 6 and 7.
[b] Rescan Environmental Services 1984, p. 45.

Table 2-5. Maximum Daily Mass Loading of Milling Reagents Reporting to Tailings[a]

PREFERRED REAGENTS	TOTAL CONC. IN EFFLUENT[b]	TOTAL MASS LOADING	ALTERNATE REAGENTS	TOTAL CONC. IN EFFLUENT	TOTAL MASS LOADING
M-502	48 mg/l	7,200 kg	SF330	2 mg/l	360 kg
Lime	32 mg/l	4,900 kg	--	--	--
Sodium silicate	15 mg/l	2,300 kg	CMC-7	11 mg/l	1,600 kg
Nokes reagent[c]	0	0	--	--	--
Fuel oil[d]	0.015 mg/l	2.2 kg	--	--	--

a Assumes 150,700 m^3 tailings thickener discharge, no recovery by recycling to process water, and application rates shown in Table 2-4.
b Prior to predilution with seawater in the mixing tank.
c Assumes complete conversion to metal sulfides or other sulfide species.
d Assumes 99% of collector remains with ore concentrate (U.S. Borax 1983b, p. 8-40).

LC50 values for freshwater fish and zooplankton tested in sediment-laden river water were 12 and 7 times greater, respectively, than the average toxicity values determined for the same species in tests using high quality, filtered water. Formation of non-toxic complexes with dissolved anionic organic materials should also reduce toxicity of M-502 and SF330 (Boethling 1984, p. 1070, 1074). Little is known about their diagenesis; SF330 is known to have high BOD (100 mg/g) and COD (200 mg/g). M-502 is reported to be biostatic (i.e., have little BOD) and have a COD of 220 mg/g (Hart pers. comm.). Due to their labile chemical configuration, microbial degradation should take place. However, chemical degradation and mechanical breakage of the polymer could result in the release of soluble cationic quaternary ammonium salt groups and increase their toxicity (Boethling 1984, p. 1071). The toxicity of degradation products apparently depends on the specific nature of the parent compound, which is presently unknown. How much of the total loading will be available to degradation is speculation due to rapid burial of some of the adsorbed fraction in zones of active deposition and to complex folding of these huge molecules, making access to some parts difficult. More information is needed on the environmental fate of these two compounds.

CMC-7 (sodium carboxymethyl cellulose), if used, adsorbs preferentially to silicate minerals and may occur in the effluent. Eventual breakdown into simple sugars should occur in both aerobic and anaerobic conditions, although the time scale is impossible to estimate. Although a high BOD is associated with this chemical, degradation is difficult (Read and Manser 1976, p. 246).

Frother compounds are likely to occur only as minor contaminants in the effluent since they will either report to the ore concentrate or may be recycled in the water reclaimed from the ore thickener or tailings thickener. MIBC (methyl isobutyl carbinol) and ALFOL-6 (1-tetradecanol) are likely to undergo rapid degradation. MIBC also may rapidly evaporate in the flotation cells (Poling 1984, p. 3). The non-toxic nature of these two aliphatic, relatively insoluble alcohols and their breakdown products suggest that there will be no substantial impacts from discharge other than to contribute to BOD. Dowfroth 250 is generally considered nonbiodegradable (Read and Manser 1976, p. 246).

Stepanflote 85L is used to help emulsify the fuel oil used as a collector. In tests at other molybdenum mines, over 99 percent of the fuel oil is retained in the molybdenite concentrate (U.S. Borax 1983b, p. 8-40). Based on the proposed application rate (Table 2-4), this would result in 0.015 mg/l in the effluent. At Island Copper, concentrations of fuel oil in the effluent were around 0.01 mg/l (U. S. Borax 1983b, p. 8-40). Roughly 60-70 percent of this will be associated with solids in the tailings.

While mass loading at this concentration is very small (2.2 kg/day), fuel oil is very toxic, and every measure should be taken to minimize the discharge of this substance.

Nokes reagent is an inorganic constituent that reacts with water to form thiophosphate and hydrosulfide ions at the pH of the flotation process. The pH has a major impact on the equilibrium between H_2S and the hydrosulfide ion. H_2S is very toxic to marine organisms and is highly soluble. The reactive minerals in the tailings will precipitate out most of the H_2S as insoluble sulfide. The amount of dissolved H_2S or hydrosulfide ion remaining in the discharge is speculative due to the complex kinetics of the reaction series. H_2S in the presence of oxygen oxidizes at a fast rate to less toxic sulfate. The oxidized forms, however, are ineffective as flotation depressants, and some milling plants sparge cells with inert gas rather than air (Poling 1984, p. 6). It is not determined what practice will be used by U. S. Borax (Reim pers. comm.), therefore, it is not clear whether significant oxidation of the hydrosulfide ion or H_2S will occur in the flotation cells prior to discharge. Aeration of the thickeners or the effluent prior to discharge should remove much of the potential toxicity of the sulfides, but treatment should be designed such that air bubbles do not occur in the effluent at the outfall.

E.V.S. Consultants (1984a) conducted chemical analyses of the pilot plant tailings (prior to dilution with seawater; see Table 2-3) used in bioassay tests. The analyses included gas chromatography/mass spectrometer screening for EPA organic priority pollutants. The priority pollutant screening for base-neutral, pesticide, and polycyclic aromatic hydrocarbon compounds detected no priority pollutants at a general detection limit of 12 ug/l (ppb). This detection limit is too high for pesticides but should be adequate for detecting other potentially toxic organic compounds contributed by the addition of milling chemicals. The only organic compound detected in the priority pollutant analyses proved to be a long-chain alcohol (2,5,8,11-tetraoxatetradecan-13-ol,4,7,10-trimethyl) that is not a listed priority pollutant. A semi-quantitative analysis determined the concentration to be on the order of 50-100 ppb. Failure to detect diesel fuel-related compounds (i.e., naphthalene and phenanthrene) is not conclusive at the 12 ppb level. These are minor constituents of diesel fuel, a complex mixture that is expected to reach concentrations of around 10-15 ppb in the effluent (of which 30-40 percent will be dissolved). No reagent standards were run by E.V.S. Consultants to compare to the tailings analysis and allow identification of any reagents present with the tailings. It is not known if any other tests have been done on the pilot plant effluent for organic pollutants, including fuel oil constituents.

Miscellaneous Effluent Constituents

Boca de Quadra. Domestic sewage from the Tunnel Creek housing facility will be discharged with the mill tailings if the discharge of tailings is directed to Boca de Quadra. The sewage will receive secondary treatment and chlorination. The sewage discharge (0.0013 m^3/sec [0.0288 mgd]) represents <0.1 percent of the total discharge; therefore, constituents in the sewage will be diluted >1,000:1 by the tailings prior to mixing and discharge. Thus, if the sewage effluent BOD is 30 mg/l, the contribution to the total BOD of the tailings will be 0.03 mg/l. This additional BOD concentration will be further reduced by predilution in the mixing tanks, and is not expected to cause adverse impacts in Boca de Quadra.

If discharge of tailings is directed to Boca de Quadra, 0.13 m^3/sec (2.88 mgd) of tunnel drainage will be discharged with the tailings. This drainage is expected to consist of uncontaminated groundwater. Dissolved oxygen concentration of groundwater discharge is not known; however, predilution with seawater in the mixing tanks is expected to minimize potential DO problems as well as reduce tendency for development of a positively bouyant freshwater plume. No impacts are expected to result from this discharge.

Wilson Arm. No additional effluents will be disposed of through the mill tailings outfall to Wilson Arm. Sewage and other wastewaters will be discharged through the marine terminal wastewater outfall.

Marine Terminal Wastewater Outfall Characteristics

The marine terminal wastewater outfall will discharge treated sanitary sewage from the marine terminal and Tunnel Creek package treatment plants, treated equipment washdown water from the fuel oil storage area and marine terminal facility, and stormwater runoff from the terminal and fuel oil storage areas.

The outfall will be located at a depth of 6 m (20 ft) approximately 55 m (180 ft) from shore in the southern half of the marine terminal facility.

Marine Terminal Wastewater Effluent Composition

Treatment Process

Sewage from the power plant (1 gpm), Tunnel Creek camp (16 gpm), ore process area (1 gpm), and administration and service warehouse buildings (2 gpm) will undergo secondary (activated

sludge) treatment and chlorination at the Tunnel Creek package sewage treatment plant (U.S. Borax 1985). Sewage from the marine terminal facility (3 gpm) will also be treated in this manner at a second package plant. The activated sludge process uses bacteria to consume organics while the wastewater is vigorously aerated. If properly designed, operated, and maintained, package plants using this process can provide good quality secondary effluent, and impacts to biota in Wilson Arm are not expected outside the mixing zone.

Equipment washdown water from the fuel oil storage area and marine terminal facility will be treated in a conventional oil/water separator prior to discharge. A stormwater retention pond will be provided to remove the majority of suspended solids from surface runoff from the marine terminal and fuel oil storage areas.

Physical Characteristics

The average daily volume of domestic sewage will be approximately 33,000 gal/d (23 gpm), and the volume of washdown water will be approximately 5,800 gal/d (4 gpm) (U.S. Borax 1985, Water Flow Schematic). The volume of stormwater runoff will vary significantly, with highest flows occurring from May to October. The wet climate results in an estimated average daily stormwater runoff discharge of 205,000 gal/d (142 gpm) and an estimated maximum of 3.1 mgd. Thus, the wastewater outfall is expected to discharge an average of 0.24 mgd, with a maximum of 3.1 mgd. Other physical characteristics of the effluent are summarized in Table 2-6.

Chemical Composition

The chemical constituents expected in the effluent (as reported by U.S. Borax 1985) are summarized in Table 2-7. Most of these constituents are associated with the sewage. As a result, the concentrations of these constituents depend on the degree of dilution with stormwater runoff. The maximum values noted for effluent in Table 2-7 represents concentration during periods of no stormwater flow (i.e., a discharge volume of about 39,000 gal/d). Most of the heavy metal loading is derived from the natural metal levels in raw water from the project area (U.S. Borax 1985), thus, the major pollutant constituents in the sewage fraction of the effluent are suspended solids, oil and grease, BOD, ammonia, and chlorine. Equipment washdown water and storm runoff are expected to add to suspended solid and oil and grease loading.

Assuming a discharge of 39,000 gal/d (i.e., no stormwater runoff), the daily BOD in the upper water column of Wilson Arm will be 5.6×10^6 g O_2, based on a maximum BOD_5 of 45 mg/l.

Table 2-6. General Characteristics of Marine Terminal Wastewater Effluent

	EFFLUENT[a]		SMEATON BAY
	AVERAGE	RANGE	
pH	--	6-9	7.3-8.8[b]
Summer temperature, °C	13	12-21	12-21[b]
Winter temperature, °C	1.7	0-21	5-12[c]
Total suspended solids, mg/l	30	15-45	5[d]

[a] U.S. Borax 1985.
[b] VTN 1981b, pp. 6-11.
[c] Nebert 1985
[d] Maximum value, usually <1.0 mg/l (Burrell 1983, p. 11, Figures 3.9-3.10).

Table 2-7. Chemical Constituents in Marine Terminal Wastewater

	EFFLUENT[a]		SMEATON BAY[b]
	AVERAGE	MAXIMUM	
Ammonia, mg/l	2.1	15	--
BOD_5, mg/l	14	45	--
Oil and grease, mg/l	5	15	--
Aluminum, ug/l	7.8	110	--
Arsenic, ug/l	2	29	--
Copper, ug/l	0	9	0.49
Lead, ug/l	4	46	--
Mercury, ug/l	0.3	4.6	--
Selenium, ug/l	0.8	11.5	--
Zinc, ug/l	4.7	78.1	--

[a] U.S. Borax 1985.
[b] From Table 2-3.

Similar assumptions result in a daily ammonia loading of 1.9 x 10^6 g. These are likely to be readily diluted in the mixing zone (Section 8), and no adverse effects on biota are expected.

Two probable constituents in the wastewater effluent that are of potential concern in the nearfield are chlorine and dissolved petroleum hydrocarbon compounds. Chlorinated wastewater has been shown to be hazardous to anadromous fish species; EPA (50 FR 30788 29 July 1985) established a criterion of a 4-day average concentration of chlorine-produced oxidants not to exceed 7.5 ug/l more than once in 3 years. The concentration of chlorine in secondary treated effluent depends on a number of important factors and is often highly variable over short periods of time. Important factors include: the design of the facility, the point in treatment at which chlorination occurs, the amount of chlorine used, and operational status of the plant. Insufficient information exists to characterize the chlorine content of the marine terminal wastewater effluent. Dechlorination prior to discharge would eliminate this potential hazard.

It is possible that water soluble fractions of fuel oil could occur in the effluent since equipment washdown water and stormwater runoff from fuel oil storage and the marine terminal areas are included in the discharge. Conventional oil and grease treatment will not effectively remove the dissolved hydrocarbon constituents, although it is possible some adsorption and settling with solids would occur in the stormwater retention pond. Insufficient information exists to estimate the concentration of water soluble petroleum fractions in the effluent.

Section 3

TRANSPORT, DEPOSITION, AND PERSISTENCE OF TAILINGS

Summary

Two alternative discharge locations are being considered in Boca de Quadra: an inner basin and a middle basin discharge. With inner basin discharge, approximately 148 million and 1,343 million tons of tailings would be discharged to the inner and middle basins respectively. Discharge to the inner basin would convert the inner basin into a relatively shallow embayment. Discharge to either basin would have little impact on the physical fjord-like character of the middle basin. Discharge to the middle basin would have minimal impact on the inner and outer basins.

In Smeaton Bay, tailings would be discharged to the eastern shoreline of Wilson Arm. The volume of tailings is large enough in relation to the basin that it would convert Smeaton Bay from a deep basin-and-sill fjord to a basin-less system.

The behavior of discharged tailings has been predicted based on observations at Island Copper Mine, which has discharged continuously for about 17 years into a fjord (Rupert Inlet) near the north end of Vancouver Island, and by mathematical and laboratory modeling. In the near field (at distances 100 m), laboratory experiments show that under steady-state conditions it is possible to maintain a slurry that does not generate clouds of fine sediments.

In the far field, a continual source and flux of fine materials into fjord waters will occur from the discharge, from turbidity currents, and from slumping of tailings. Most fine materials should not extend above outfall depth. Within 15-20 m of the seabed, concentrations of fines would typically range from 200-2,000 mg/l just above zones of active tailings flow based on Rupert Inlet.

The predominant sources of suspended fines are expected to be slumping events or similar large scale (mass movement) changes in deposition patterns. If an inner basin discharge is used, tailings discharge and associated introduction of suspended particulates in Boca de Quadra will be confined to the inner basin in early years. After 10-14 years of operation, the inner basin will be filled to the sill depth and significant amounts of material will be transported over the sill to the middle basin. For the remaining 41-45 years of operation, source areas for suspended sediments will occur in the middle basin, moving downfjord toward Kite Island sill. Most deposits and therefore

most mass movement events will be below 80 m (260 ft) in the inner basin and 150 m (490 ft) in the middle basin. The middle basin appears to have sufficient grade to maintain coherence of the tailings density current leaving the outfall.

Discharge to Smeaton Bay would result in progressive mass movement along the length of the fjord. Introduction of suspended particulates will occur at gradually shallower depths as the fjord is filled.

Uncertainties exist concerning the equilibrium slope for tailings over time in the few kilometers surrounding the outfall. The slope may result in tailings pile-up at the outfall with backfill occurring into Wilson Arm before flowing (if ever) over the sill into Behm Canal. In the later years of mining operations, if the tailings do not behave entirely as predicted, there is a risk they would deposit on the toe of the estuary.

A fjord circulation model has been developed to project the transport of suspended solids. The model for Boca de Quadra suggests that an inner basin discharge would produce higher concentrations of suspended materials at shallower depths in the inner basin than a middle basin discharge. A discharge to the inner basin would also elevate suspended sediment concentrations to within the normal range of the pycnocline in the inner basin more than would a middle basin discharge. A middle basin discharge would result in increased sedimentation rates (4-15 cm/yr) in the inner basin. Discharge into either basin of Boca de Quadra would increase concentrations of suspended particulates upfjord of the Kite Island sill. The Kite Island sill will inhibit seaward migration of most suspended materials; however, EPA modeling indicates suspended materials will enter the outer basin.

A fjord circulation model has also been applied to Smeaton Bay. The system is simpler because the entire bay above the depth of the outer sill has free communication with the waters of Behm Canal. Because of the freer communication with coastal waters, suspended sediments in Smeaton Bay are less likely to reach the shallower depths expected in Boca de Quadra because they are more likely to flush out into Behm Canal. Fjord modeling predicts outward transport of suspended fines across the outer sill into Behm Canal. The ultimate fate of sediments leaving Smeaton Bay cannot be predicted. They are likely to be rapidly diluted and dispersed if the prediction on suspended fines moving over the outer sill is correct.

The amount of energy necessary to vertically transport fine suspended solids from near bottom water to higher elevations can be calculated from salinity, temperature, and density data

collected in the two fjord systems. Comparison between the fjord systems can be made on a seasonal basis and between pre- and post-discharge conditions. The calculations indicate proportionately large decreases in required energy for the inner basin of Boca de Quadra, small decreases for the middle basin of Boca de Quadra, and intermediate decreases for Wilson Arm and Smeaton Bay.

At project completion, circulation in Smeaton Bay will be affected. There will be no retention and slow mixing of dense water brought in during summer deepwater renewal. Consequently, density-driven winter currents will not exist, and wind and runoff will be of increased importance in determining circulation.

Introduction

This section concerns the physical aspects of mill tailings disposal in Boca de Quadra and Smeaton Bay fjords, located in southeast Alaska. The purpose of this section is to obtain sufficient understanding of how the discharge will behave (i.e., its dilution and dispersion) in order to assess the resulting biological consequences (Sections 5, 6 and 8). Listed below are some of the concerns which are addressed in this section:

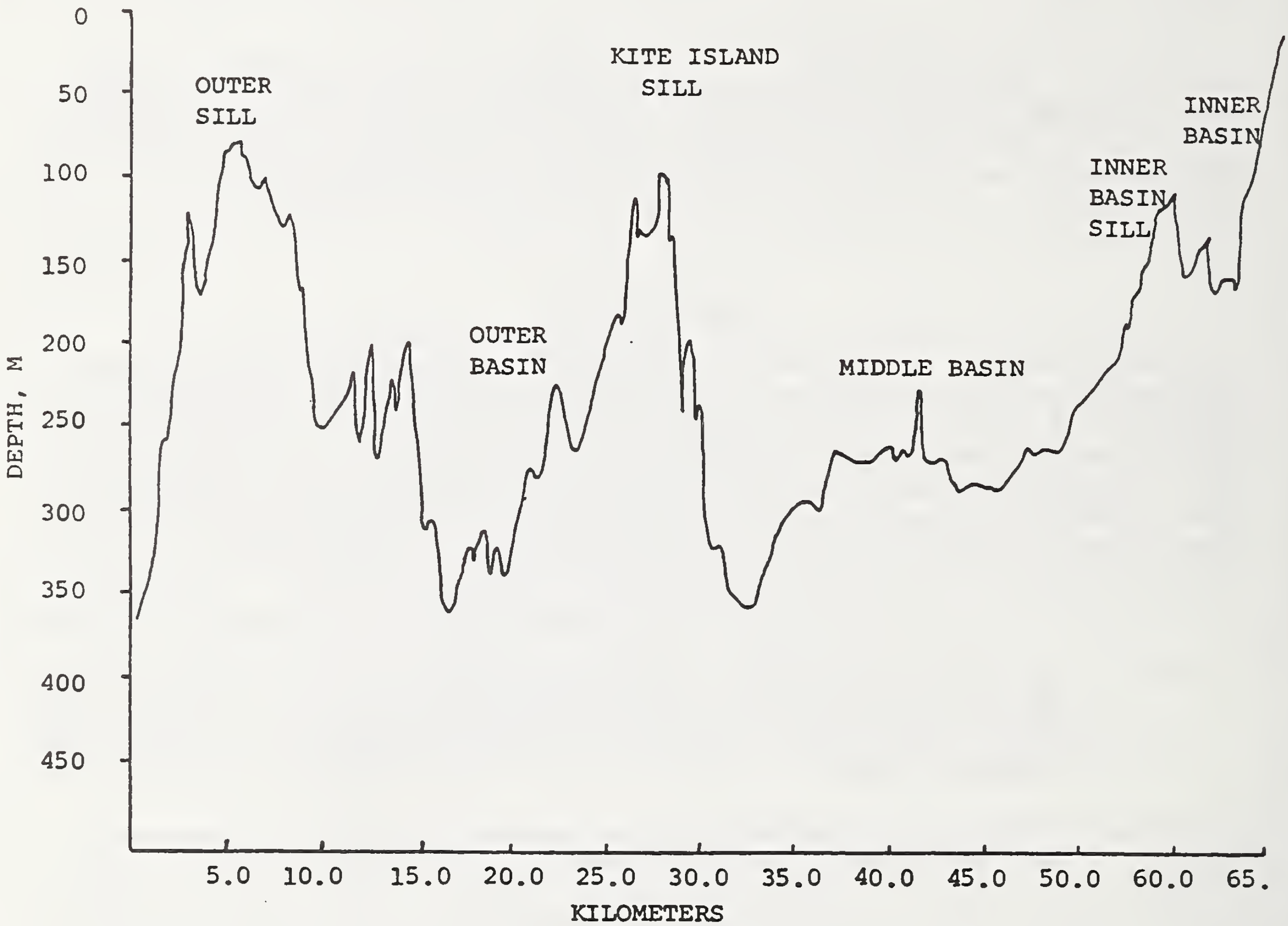
1) Will discharged mill tailings remain within the fjord?

2) How do discharges into the middle basin or inner basin of Boca de Quadra compare to discharge into Smeaton Bay with regard to impacts on the bottom and within the euphotic zone?

3) What are the depths below which the bulk of suspended sediments will be confined?

4) How will oceanographic conditions change as a result of tailings deposition?

Boca de Quadra is a deep, multi-silled fjord which extends about 57 km (35.5 mi) from its outermost sill in Revillagigedo Channel to its head at the Keta River estuary (Figure 2-2). Four smaller side arms (Badger Bay/Weasel Cove, Vixen Bay, Mink Bay, and Marten Arm) extend from the middle reach of Boca de Quadra. Seaward of the Keta River are three sill-separated basins: the inner basin, the middle basin, and the outer basin. Figure 3-1 shows longitudinal bathymetry of Boca de Quadra fjord. The depths of the major bathymetric features are presented in Table 3-1.



Note: Maximum basin and sill depths may differ from this longitudinal section (Table 3-1).

BOCA DE QUADRA LONGITUDINAL BATHYMETRIC SECTION

FIGURE 3-1

SOURCE: Burrell 1983

Table 3-1. Boca de Quadra Fjord Characteristics

BASIN	LENGTH (km)	SILL[a] DEPTH (m)	MAXIMUM BASIN DEPTH (m)	BELOW SILL-DEPTH VOLUME VOLUME[b] (million m^3)
Outer	22	85	375	
Middle	27	95	400	4,300
Inner	8	110	170	100

[a] Maximum depth in channels across the sill.
[b] Ryan 1983, pp. 13 and 18.

The Smeaton Bay fjord consists of one main basin that extends from the outer sill (130 m [430 ft] depth) to the shoaling at the confluence of Wilson and Bakewell Arms (Figure 2-3). Both arms shoal gradually from a small sill (150 m [490 ft]) at their mouth to their respective heads. The main basin of Smeaton Bay is split by a relatively deep sill (200 m [656 ft]). The longitudinal bathymetry for Smeaton Bay extending from Behm Canal into Wilson Arm is shown in Figure 3-2. The depths of the major bathymetric features are presented in Table 3-2.

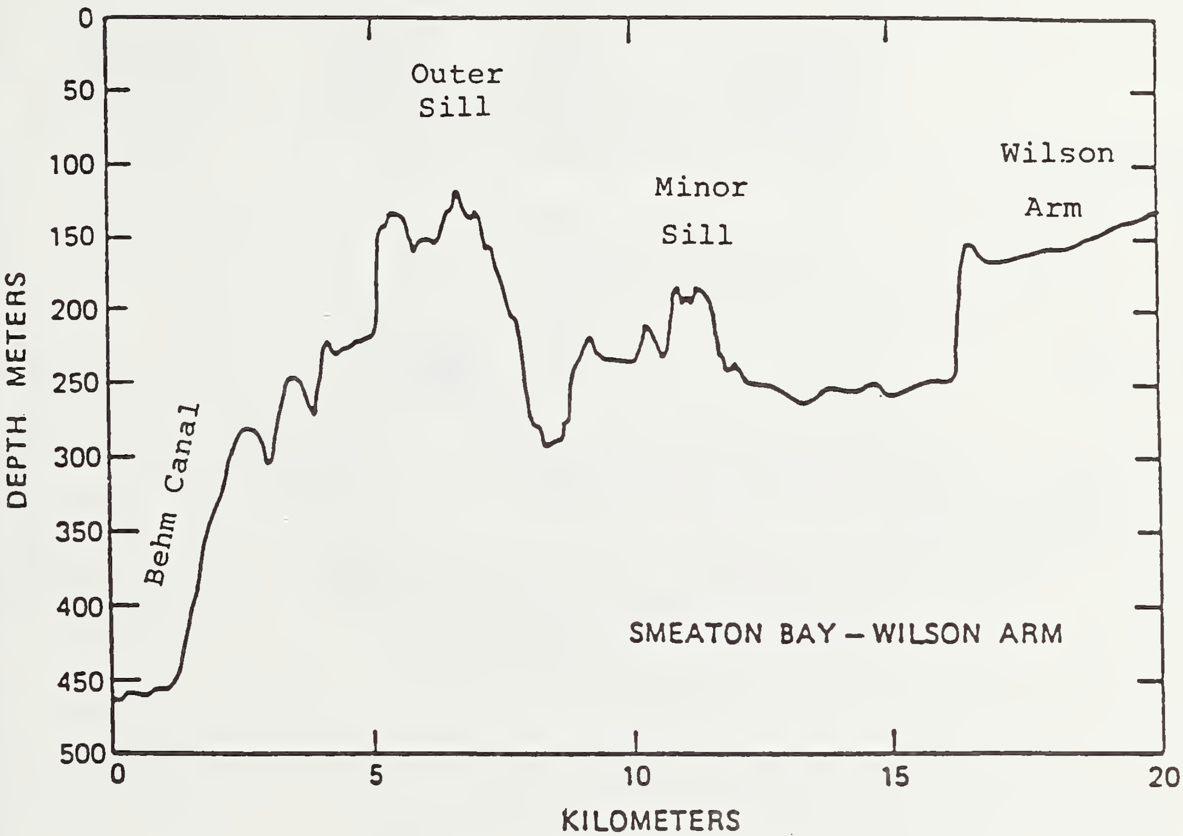
Impact of Tailings Discharge on Fjord Bathymetry

Boca de Quadra

Two alternatives for discharge locations in Boca de Quadra are under consideration: a discharge into the inner basin and a discharge into the middle basin. Because either alternative has most (71-100 percent) of the discharged material accumulating in the middle basin, the discussion in this section focuses on impacts of the two alternatives on the inner basin. For purposes of this discussion, the density of deposited mill tailings (at typical deposition depths) is assumed to be 1.59 g/cm^3 (100 lbs/ft^3). This number represents the average compacted density of sediments deposited at depths in excess of 50 m (160 ft). The tests to determine the compacted density of tailings were performed at the University of British Columbia (Rescan Environmental Services, 1984) on two samples obtained from pilot plant tests. Earlier reports on deposited tailings had assumed 1.14 g/cm^3 (71.5 lbs/ft^3) for the _in situ_ density. For the studies of tailings disposal in Boca de Quadra the difference in density is insignificant.

For a discharge into the inner basin at an average rate of 60,000 t/day at a specific gravity of 1.47, the inner basin would be filled to the depth of the sill separating it from the middle basin after a period of 10-14 years. For the remaining 41-45 yrs of operation, the discharged material would settle into the middle basin of Boca de Quadra. Figure 3-3 illustrates the deposition patterns during several stages of mining operation.

By the end of the project, approximately 284 million metric tons (306 million tons) of tailings will have been deposited in the inner basin and 1.05 billion metric tons (1.13 billion tons) in the middle basin. Assuming a consolidated tailings density of 1.59 g/cm^3 (100 lb/ft^3), the following decreases in basin volumes (below the depth of the sill) can be expected:



SMEATON BAY LONGITUDINAL BATHYMETRIC SECTION

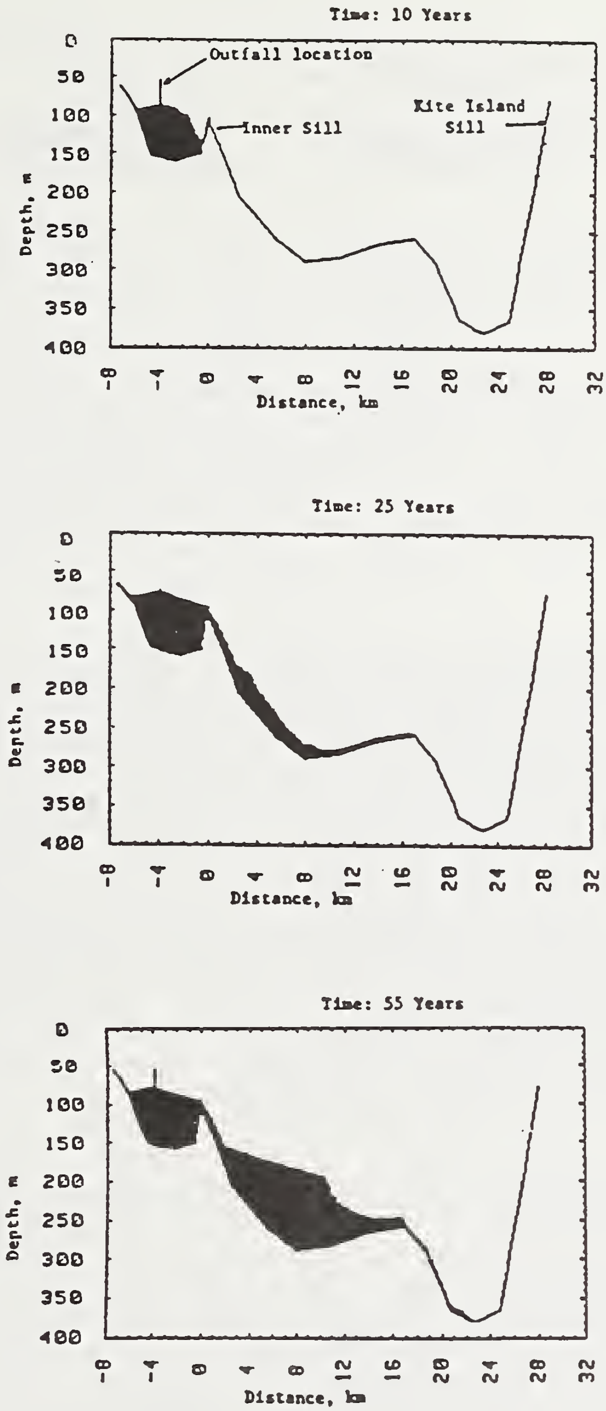
FIGURE 3-2

SOURCE: Burrell 1983, Figure 1-4

Table 3-2. Smeaton Bay Fjord Characteristics

	LENGTH (km)	SILL DEPTH (m)	MAXIMUM DEPTH (m)	BELOW-SILL VOLUME (10^6 m^3)
Smeaton Bay[a]	20	--	295	777[b]
Outer Sill	--	130[b]	--	--
Minor Sill	--	~200	--	--
Wilson Arm	9	150	160	--

[a] Including Wilson and Bakewell Arms.
[b] U.S. Borax 1986



LONGITUDINAL CROSS-SECTION OF PREDICTED TAILINGS DEPOSITION IN BOCA DE QUADRA

FIGURE 3-3

SOURCE: Ryan 1985a

	Pre-operational Below Sill Volume (million m^3)	Volume of Tailings (million m^3)	Below Sill Percent Decrease
Inner (10-14 years)	100	180	100
Middle (55 years)	4,300	665	15

Thus, the inner basin discharge would eliminate the basin-and-sill configuration of the inner basin; however, discharge to either basin would have little impact on the basin-and-sill character of the middle basin. Direct discharge to the middle basin would decrease below-sill capacity of the middle basin by 20 percent.

Smeaton Bay

Mill tailings would be discharged into Wilson Arm at a depth of 46 m (150 ft) at a location along the eastern shoreline approximately 4.1 km (2.6 mi) from the fjord head. For discharge to Boca de Quadra, the density of tailings was not important to calculation of deposit volume. An important factor to consider in evaluating Smeaton Bay discharge is the relationship of below-sill volume (7.8×10^8 m^3) to tailings solids volume. The density current/sedimentation model (Findikakis 1985) may underestimate the volume the tailings discharge will occupy in the marine environment in two ways. First, the assumption on tailings dry densities used in the model are based on tests reported by Rescan Environmental Services (1984, Appendix A) on two Quartz Hill pilot plant tailings samples. Uncompacted dry densities (4 days settlement) for saltwater solution samples ranged from 57-61 lb/ft^3, significantly less than 71.3 lb/ft^3 used for the initial dry density in the model. This could result in the underestimation of the volumes of surface layer and shallow deposits. Second, the saltwater solution samples occupied approximately 5 percent greater volume after initial settlement than freshwater solution samples. The volume increase after compaction has not been determined. Increases in total volume of deposited tailings on the order of 5 percent over those predicted in the model are possible. Assuming a density of 100 lb/ft^3, Rescan Environmental Services (1984, p. 61) calculated a tailings volume of 8.5×10^8 m^3. This value is 9 percent greater than the below-sill volume, but it does not include the volume of tailings that occur in the pile above the plane of the sill in Wilson Arm and the upper reach of Smeaton Bay. Any increases over predicted volumes or an error in the predictions in the sedimentation model could result in the overfilling of Smeaton Bay.

The feasibility study (Findikakis 1985) for a discharge located in Wilson Arm used the following assumptions:

- A discharge rate of 40,000 t/d for the first 5 yrs of operation and 80,000 t/d for the remaining 50 yrs.

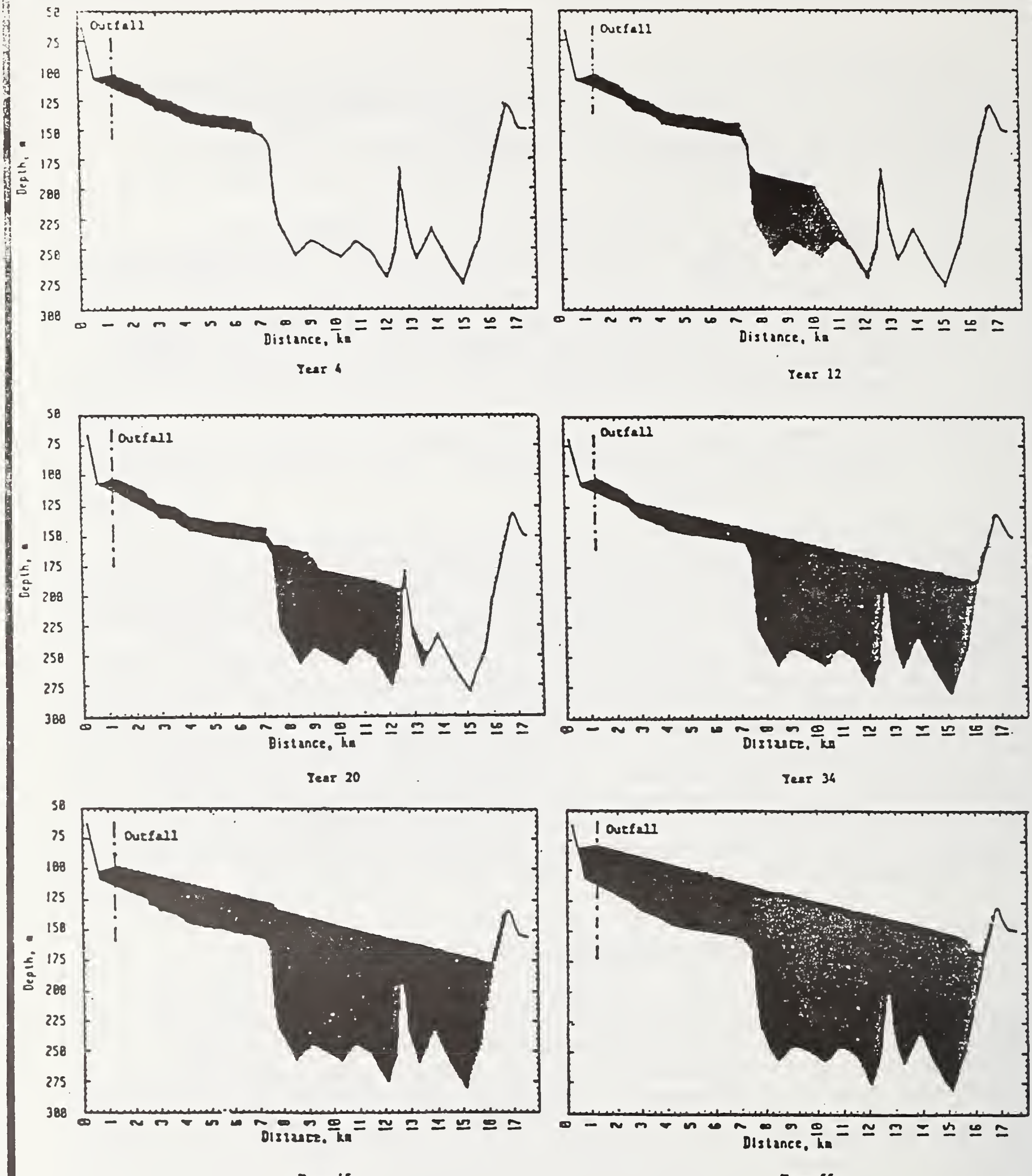
- The average <u>in situ</u> density of sediments was 100 lb/ft^3. A curve derived by Rescan Environmental Services (1984) describing the density of compacted sediments as a function of depth was used for the actual calculations. This was done in the calculations in lieu of using a time-varying compaction in which increased deposition on top of previously deposited sediments would increase compaction.

- The model used the best available cross-section of the bathymetry to estimate volumes. The bathymetry was from a NOAA survey in 1982.

Based on these assumptions, the Wilson Arm basin would fill to its sill depth in about 4 years. The discharge would then begin to fill up the inner "basin" of Smeaton Bay. By year 12, the leading edge of deposited tailings would have reached the base of the deep middle sill. In about year 20 of operations, the tailings would have filled the inner "basin" to a depth of the sill and subsequent tailings would penetrate to the outer "basin" of Smeaton Bay. By year 34, there would be a uniform slope of tailings from the source to about two thirds the way up the sill separating Smeaton Bay from Behm Canal. By the end of 55 years of anticipated mine operations, the tailings would have risen to within 45 m (150 ft) of the top of the outer sill. Thus, discharge to Wilson Arm would convert Smeaton Bay from a basin-and-sill fjord system to a bay-like system. This progressive filling process is shown in Figure 3-4.

<u>General Description of Tailings Behavior</u>

The mill tailings are primarily quartz with a density of about 2.65 g/cm^3. They are ground and mixed with water and flotants to achieve densities between 1.332 and 1.452 g/cm^3 (Section 2). This mixture, of approximately equal weights of water and quartz, is pumped or gravity-fed from the thickeners to the fjord where it is then further diluted before discharge into the marine environment. These dilutions range from 1:1 to 1:4 by volume with seawater before final discharge. Thus, densities of effluent entering the marine environment could range from a high of 1.202 g/cm^3 to a low of 1.075 g/cm^3. By the time the slurry leaves the near field, it will have been further diluted by entrainment of ambient water, thus, bringing the density near that of the ambient seawater (1.026 g/cm^3).



LONGITUDINAL CROSS-SECTION OF PREDICTED TAILINGS DEPOSITION IN SMEATON BAY

FIGURE 3-4

SOURCE: Ryan 1985b

This range of discharge slurry densities agrees with estimates made by Komar (1977) of densities of natural slump and mud flows. He points out that, for sand-sized sediments in the slurry, a flow with a density greater than 1.4 g/cm^3 would not be able to overcome the bottom friction and would therefore lose momentum rapidly and not propagate over large horizontal distances. This number appears to be a practical limit above which sediments would not maintain enough momentum to continually move away from the discharge. If the slurry density is too low, it will tend to mix too rapidly with ambient water. Unfortunately, it is not easy to define a lower limit. Rivers have reached concentrations of 1.06 g/cm^3 before the particulate concentrations within the water affected the river flow (Lane 1940). Thus, a range of 1.06-1.4 g/cm^3 may be required bounds for maintaining a coherent density flow.

The nearfield behavior of a prediluted jet of discharged tailings is strongly influenced by the bottom slope. The jet is also influenced to a lesser degree by the orientation of the outfall and exit velocity (Table 3-3). As the jet moves away from the discharge pipe, entrainment processes mix additional seawater into the plume (Figure 3-5). The jet increases in cross-sectional area and decreases in velocity with distance from the source. There is little deposition in the nearfield region (Findikakis 1983, p. 12). After approximately 60-100 m (200-330 ft) of travel, ambient oceanographic conditions begin to exert an influence on the discharged material. The region where the oceanographic conditions become important is called the far field. An upper plume is indicated in Figure 3-5; this feature may never occur or it may occur on a transient basis. Additional discussion on this topic is deferred to The Far Field in this chapter.

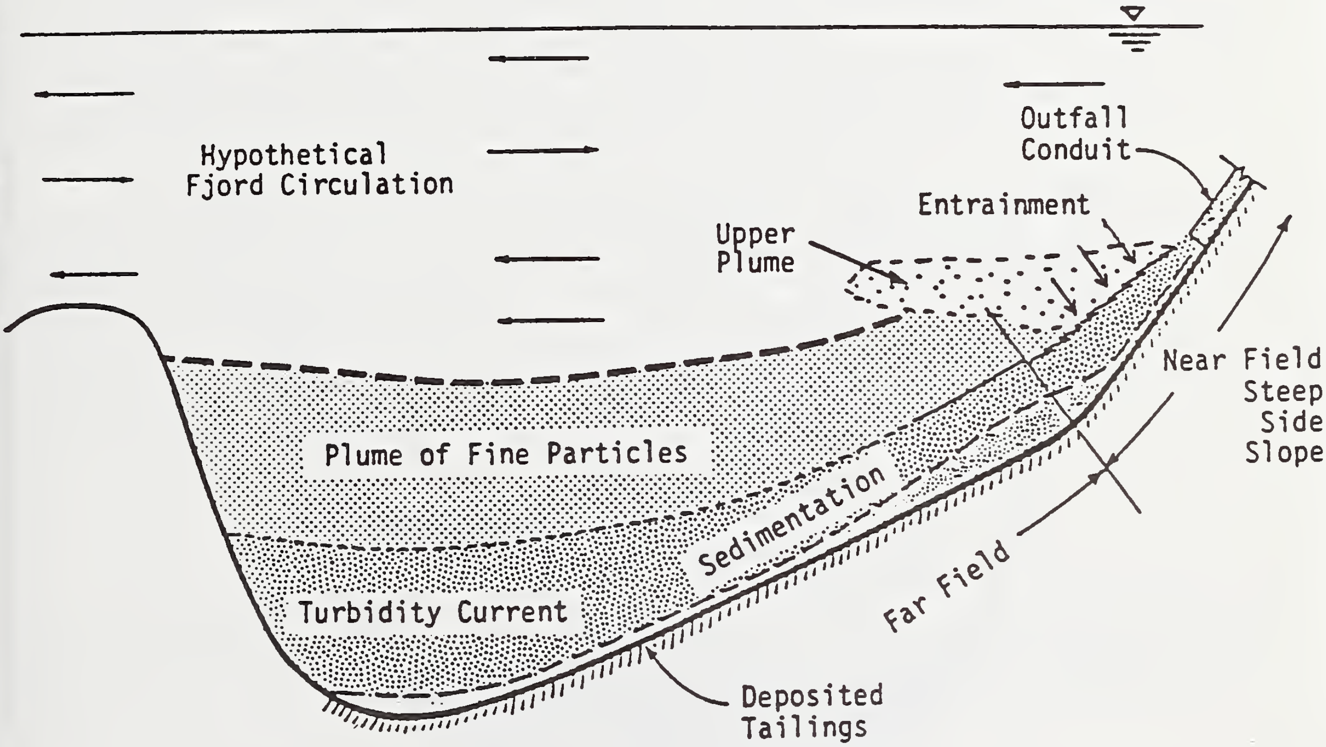
The majority of the discharged material moves as a coherent, steady current down channels leveed by previous flows (Figure 3-6). There is a tendency for the heavier particles in a discharge to scour lighter material from previous discharges and create channels. Such channels would change in time much like a meandering river as it breaks through levees and creates new channels. Factors that influence the movement of coarser tailings material are the bottom slope, ambient currents, and the geometry of the channel. The loss of fine particles to the waters of the fjord is minimal when the discharge moves in a steady confined manner. However, there will always be a small loss of some finer particles (smaller than 10 um) from the jet. Particle sizes 10 um and less are expected to represent 18 percent of the Quartz Hill tailings by weight (Paulsen pers. comm.). These particles settle slowly and advect and diffuse with the currents, eventually creating elevated background particulate concentrations in water below the discharge depth (Findikakis 1983, p. 13). Flocculation may aid in accelerating the deposition of the suspended fine particles. According to

Table 3-3. Summary of Test Conditions and Principal Results from the Nearfield Model[a] (Prototype Values)

RUN NO.	BOTTOM SLOPE (DEGREES)	PREMIXING	OUTLET DIAMETER (m)	JET VELOCITY (m/s)	DENSIMETRIC FROUDE NUMBER	FLOW TYPE	REMARKS
1	25	1.1	0.95	4.45	3.8	Jet	Exploratory Test
2	25	1.1	1.25	2.50	1.8	Jet	Exploratory Test
3	25	1.1	1.90	1.10	0.7	Jet	Exploratory Test
4	5	1.1	1.25	2.50	1.8	Jet/sheet	Exploratory Test
5	5	1.1	0.95	4.45	3.8	Jet/channel	Exploratory Test
6-11	25	1.1	1.25	2.50	1.8	Jet	Dilution Test
12-13	25	1.1	1.25	2.50	1.8	Sheet	Dilution Test
14-16	25	1.1	1.25	2.50	1.8	Channel	Dilution Test
17	25	1.1	1.25	2.50	1.8	Sheet	Dilution Test
18-19	25	1.1	1.25	2.50	1.8	Sheet	Salt Verification Test
20-21	25	1.1	1.25	2.50	1.8	Sheet	Dilution Test
22-24	25	1.1	1.90	1.10	0.7	Channel	Dilution Test
25-26	25	1.1	0.95	4.45	3.8	Sheet	Dilution Text
27	25	1.1	0.95	4.45	3.8	Channel	Dilution Test
28-30	25	1.2	1.60	2.50	2.0	Channel	Dilution Test
31-35	25	1.4	1.60	4.45	4.8	Sheet	Dilution Test
36-38	25	1.2	1.60	2.50	2.0	Sheet	Scour Test
39-42	12.5	1.2	1.60	2.50	2.0	Sheet	Dilution Test
43-46	12.5	1.4	1.60	4.45	4.8	Sheet	Dilution Test
47	12.5	1.2	1.60	2.50	2.0	Sheet	Dilution Test
48-49	12.5	1.2	1.60	2.50	2.0	Sheet	Scour Test

[a] Study tank dimensions were 39 ft long, 7.5 ft deep and 15 ft wide.

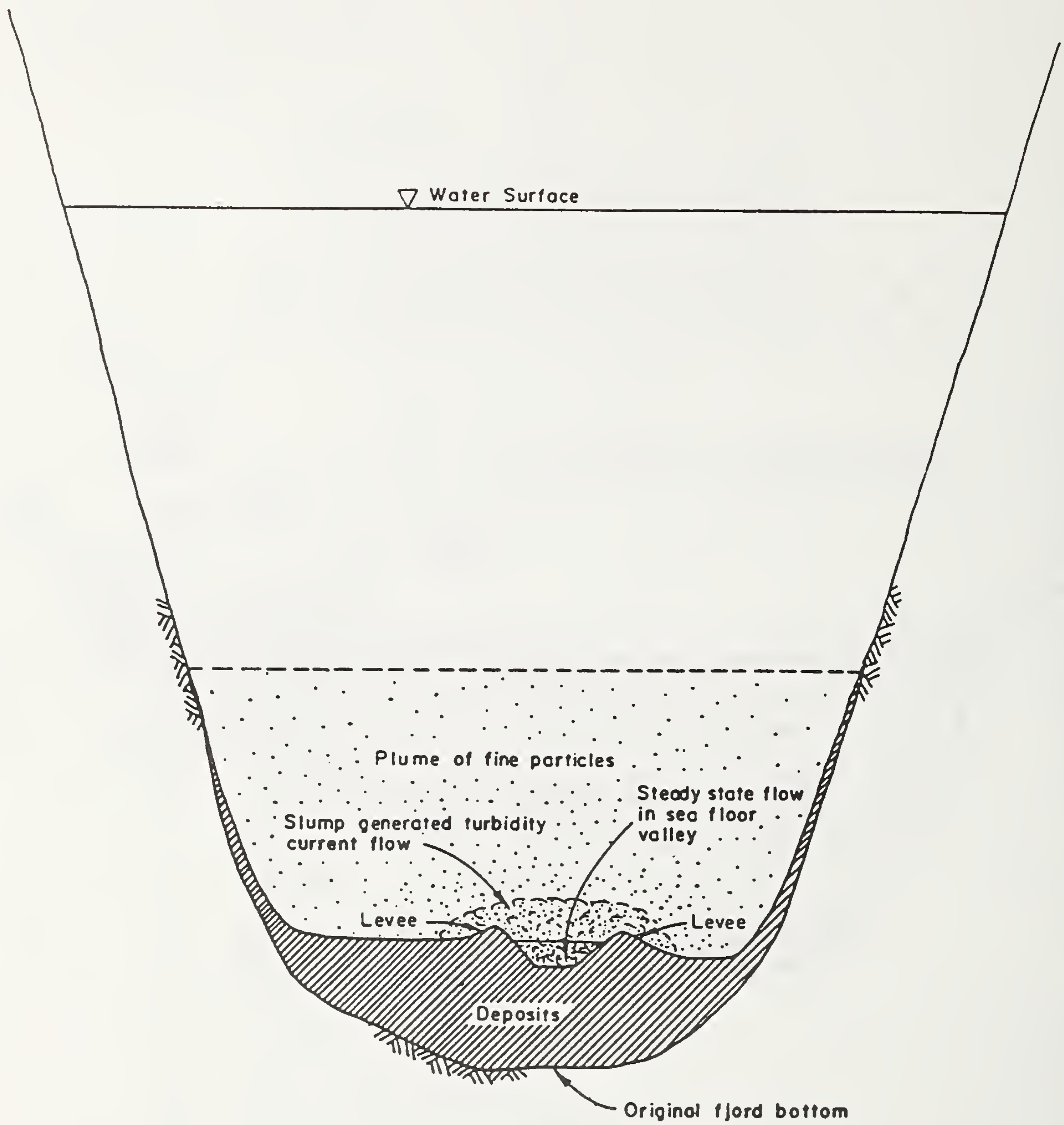
SOURCE: Jain and Kennedy 1984



REGIONS OF SEDIMENT TRANSPORT AND DEPOSITION IN A FJORD

FIGURE 3-5

SOURCE: Ryan 1983



SCHEMATIC CROSS-SECTION OF TAILINGS DISPOSAL BY SPORADIC AND STEADY STATE TURBIDITY FLOW IN A FJORD SYSTEM

FIGURE 3-6

SOURCE: Rescan Environmental Services 1984, p. 57

Rescan Environmental Services (1984), studies at the Kitsault Mine suggest that 60 percent of the tailings put into suspension settled within 24 hours.

Deposition of the coarser material begins either when the jet loses momentum due to a decrease in bottom slope or when the coarser material has diffused from the main axis of the jet into ambient conditions where it can settle to the sea floor. The long-term angle of repose of tailings on the sea floor will average about 0.5 percent, which is comparable to the slope of the abyssal regions of the fjords. Thus, throughout the tailings disposal operations, there should occur many build-ups of ledges followed by slumping and ledge rebuilding processes. With each slump some amount of the material will be put into suspension. This could be an important source of suspended solids.

In regions where the bottom slope is less steep, the velocity of the turbidity current would decrease. Where flow velocities suddenly decrease, an internal hydraulic jump may form. Turbulence associated with a hydraulic jump also could generate a cloud of tailings particles. Thus, as the turbidity current moves, it is subjected to accelerations and decelerations depending on the terrain. This current loses momentum when it flows up the sides of the fjord, is contained by sills, or slowed by frictional forces in the abyssal depths.

Modeling Effort

Because details of the events that occur in the discharge of mill tailings into fjords have not been observed, there has been considerable attention given to modeling studies of discharge behavior. Four efforts have been undertaken which are idealized and involve assumptions.

An extensive mathematical and physical modeling program has been undertaken to predict tailings and suspended solids behavior within both fjords and to understand the interactions between oceanographic conditions and the fate of the suspended tailings (Kowalik 1984; Kowalik and Findikakis 1985). A nearfield laboratory study of the discharge behavior has been completed by Jain and Kennedy (1984). A density current/sedimentation model was developed for Smeaton Bay (Findikakis 1985) and Boca de Quadra (Findikakis 1985, Ryan 1985a). EPA (1988) used a mass-balance approach, based upon diffusion, advection and particle settling, to estimate probability distributions for suspended solids. Although the EPA (1988) model was based upon results presented in the EIS, it differed from the model of Kowalik and Findikakis (1985) in two fundamental ways. First, the EPA model was a steady-state model, while that of Kowalik and Findikakis (1985) was dynamic. Second, the EPA model took a fundamentally different approach to establishing the boundary condition for

flux of mine tailings into the water column. The EPA model assumed that the lightest 10 percent of the mine tailings would be injected into the bottom boundary layer of the fjord over a 10 km distance. Kowalik and Findikakis (1985) assumed a constant concentration of 20 mg/l along the entire bottom of the fjord. The RDEIS subsequently reinterpreted the work of Kowalik and Findikakis (1985), in light of data from Rupert Inlet (RESCAN 1983), concluding that 600 mg/l was a more appropriate value than the 20 mg/l assumed by Kowalik and Findikakis.

All of the modeling efforts have some severe limitations. For example: the density current/sedimentation model does not include any aspects of fjord circulation; thus, tailings deposition patterns as modeled do not reflect the influence of bottom currents and advection of suspended solids. The fjord circulation model does not include winter simulations or wind effects, which could influence advection of suspended solids. The nearfield model also does not include currents and has not been verified with field observations; thus, model results represent untested, ideal conditions. The models and their predictions must be interpreted within the framework of the phenomena the models are designed to depict.

Nearfield Discharge Behavior

Nearfield (<150 m [500 ft]) studies of the behavior of tailings flows were done by Jain and Kennedy (1984). The purpose of the study was to describe the flow characteristics of the slurry as it initially left the discharge outlet. The study was done under laboratory conditions and the appropriate flow parameters were preserved by using nondimensional variables. In this discussion, dimensions refer to the actual and not the laboratory scale experiments. The laboratory study tank was 12 m (39 ft) long, 2.3 m (7.5 ft) deep, and about twice as wide as deep. The settling velocity for particles in the slurry and the appropriate hydrodynamic parameter (the Froude number) were preserved between the prototype model and the prototype. The tank was sufficiently large that the appropriate measure of turbulence (the Reynolds number) would not affect the interpretation of the experiments.

Although there were differences in the nature of the near-outlet flow which depended on the bottom slope and, to a lesser extent, the flow parameters (outlet size, outlet velocity, and predilution of tailings [Table 3-3]), the important observations pertain to the way in which previously deposited sediments are reworked by the incoming slurry (i.e., how the incoming slurry carves channels, maintains a jet-like structure, or spreads out sheet-like upon the existing sediments). Under no circumstances were they able to construct a slurry which broke up, intruding fines into the ambient environment in the laboratory studies.

With all discharges there is entrainment of ambient fluid with distance from the discharge. Dilution factors in the experiments (Jain and Kennedy 1984) ranged from 5:1 to 42:1 in the first hundred meters after discharge. Thus, at distances >100 m (330 ft), the density of discharged slurries can only be a few percent above that of the ambient waters. Depending on the nature of the slurry flow, the jet could still have some momentum.

There was no indication of plume "separation" in the vicinity of the outfall, except when air bubbles were present in the discharge. This suggests that air entrainment should be minimized in operations. Generation of a turbidity plume in the near field may depend on bottom slope. Rescan Environmental Services (1984, p. 68) recommended a discharge site in the Boca de Quadra inner basin with a relatively gentle slope (compared to other inner basin sites) in order to reduce the likelihood of a turbidity plume. Rescan Environmental Services believes the mid-water turbidity plume from the Kitsault Mine in Alice Arm, discussed in detail by Burling et al. (1981), may have occurred in part because of the steeper slope of the discharge (Pelletier, pers. comm.). In comparison, the slopes of middle basin Boca de Quadra and Wilson Arm are greater than that in Alice Arm.

Discharges into the marine environment are often regulated by dilution criteria specifying the minimum dilution at a given distance from the discharge. Such criteria should not be used for tailings discharges since the objective with mill tailings is to have a continuous flow of material into deeper waters far from the discharge.

The experiments by Jain and Kennedy (1984) help to interpret regimes of tailings flow that can exist from discharges of a dense slurry. There is considerable scatter in their data, however, suggesting that the nature of the discharge flow will be sensitive to parameters which may vary in time, e.g., the bottom slope near the discharge. Furthermore, the discharges were into a quiescent environment, not an environment with existing turbulence and currents. Finally, the model was not designed to simulate bed formation, bedload transport, and slumping behavior. The experiments show, however, that it is possible under steady conditions to maintain a slurry which does not diffuse clouds of fine sediments into the ambient fluid. The transient problems associated with changes in discharge rates and other time-dependent variations in production have not been discussed in the literature.

The Far Field

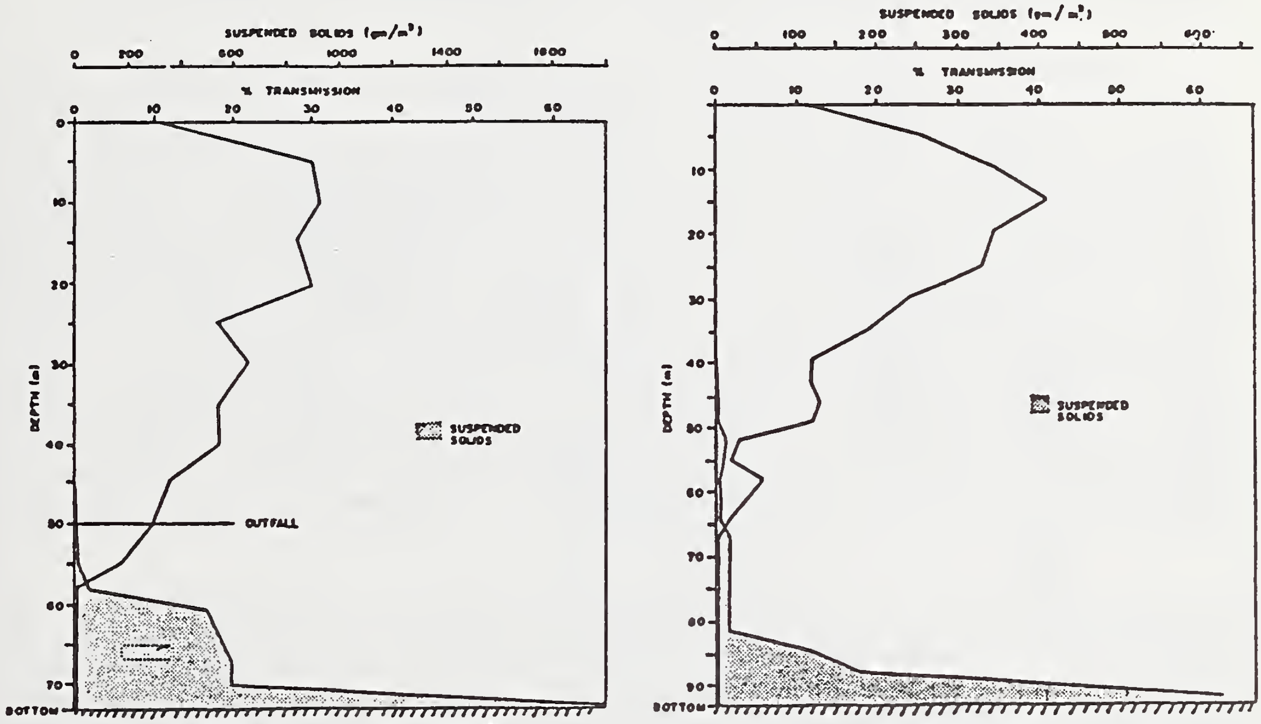
General Characteristics. The far field can be characterized as a fluvial system with building of settled slurry outcrops, erosion of outcrops, renewed momentum to the slurries as steeper

bottom slopes are encountered, and a settling of material as turbulence in the jet and media subside in intensity. Accumulation of discharged material occurs as the sediments settle by gravitational forces once turbulence in the jet dissipates. It is not possible to model all of the events which take place; therefore, only a description of material balances within basins can be surmized.

There will be a continual source and flux of fine materials (10 um or less) into fjord waters as a result of discharge, turbidity currents, and continual slumping of tailings deposited on the fjord bottom. Approximately 18 percent (Figure 2-4) of the tailings would be in this size range. The suspended fines would extend over the width of the fjord and a substantial distance above the bottom. Most of the material in this cloud would not extend above the depth of the outfall. Concentrations of the fines would range from 5-20 mg/l at the top of the cloud to high concentrations (200-2,000 mg/l) typical of the turbidity flows near the seabed (Figure 3-7).

According to the RDEIS, a vertical profile of suspended solids through the cloud should be similar to profiles observed in Rupert Inlet within 1-2 km of the outfall. Examples of profiles obtained from Rupert Inlet during the 10th year of mining operations are shown in Figure 3-7. The stippled areas refer to the concentrations, and the lines are the transmissivity of the waters. High transmissivity implies clear water. Suspended solids were as high as 2,000 mg/l within the plume, dropping below 20 mg/l at 15 m and 41 m above the bottom at distances of 300 m and 1,000 m from the discharge, respectively.

A potential source of suspended fine material is separation of the fines from the density current as the slurry moves down into the fjord (Figure 3-5). Under some conditions the plume might separate (i.e., introduce a quantity of fine materials into the fjord) after approximately 60-100 m (200-330 ft) of travel, i.e., transformation from nearfield to farfield conditions. If release of fines occurs at this stage, it would occur at depths of approximately 88-120 m (290-390 ft) assuming an outfall depth of 46 m and a 50 percent slope down the fjord wall. Assuming a more gradual slope, the depth range for this type of event would be even shallower. This could place suspended fines near the upper water column. Although it was not possible to reproduce plume separation in the laboratory studies, the receiving waters were stagnant in these studies. This has importance for understanding the model limitations and its ability to reproduce field conditions. Where water depths are shallow, tide currents and turbulence may be appreciable. It is at this point that the strongest interactions would be expected to occur between ambient fluid and slurry that has lost most of its original momentum. If separation were to occur, this is where it would be expected. This type of plume separation has been observed at the Kitsault



300m downstream from outfall.

1000m downstream from outfall.

PROFILES OF SUSPENDED SOLIDS IN RUPERT INLET

FIGURE 3-7

SOURCE: Envirosphere 1984, Figure 4-5

mine. Goyette et al. (1985) reported that a midwater tailings plume persisted at a depth between 80 and 120 meters. They reported maximum residue (total suspended particulate) concentrations of 104-128 mg/l within the plume. This feature of the discharge is included in Figure 3-5. Topographic features might also induce separation. Such features would tend to be smoothed out as the bottom develops smooth channels after some time of operation. Channels would reduce both tidal current effects and topographic effects, lessening any tendency to release fines to the waters.

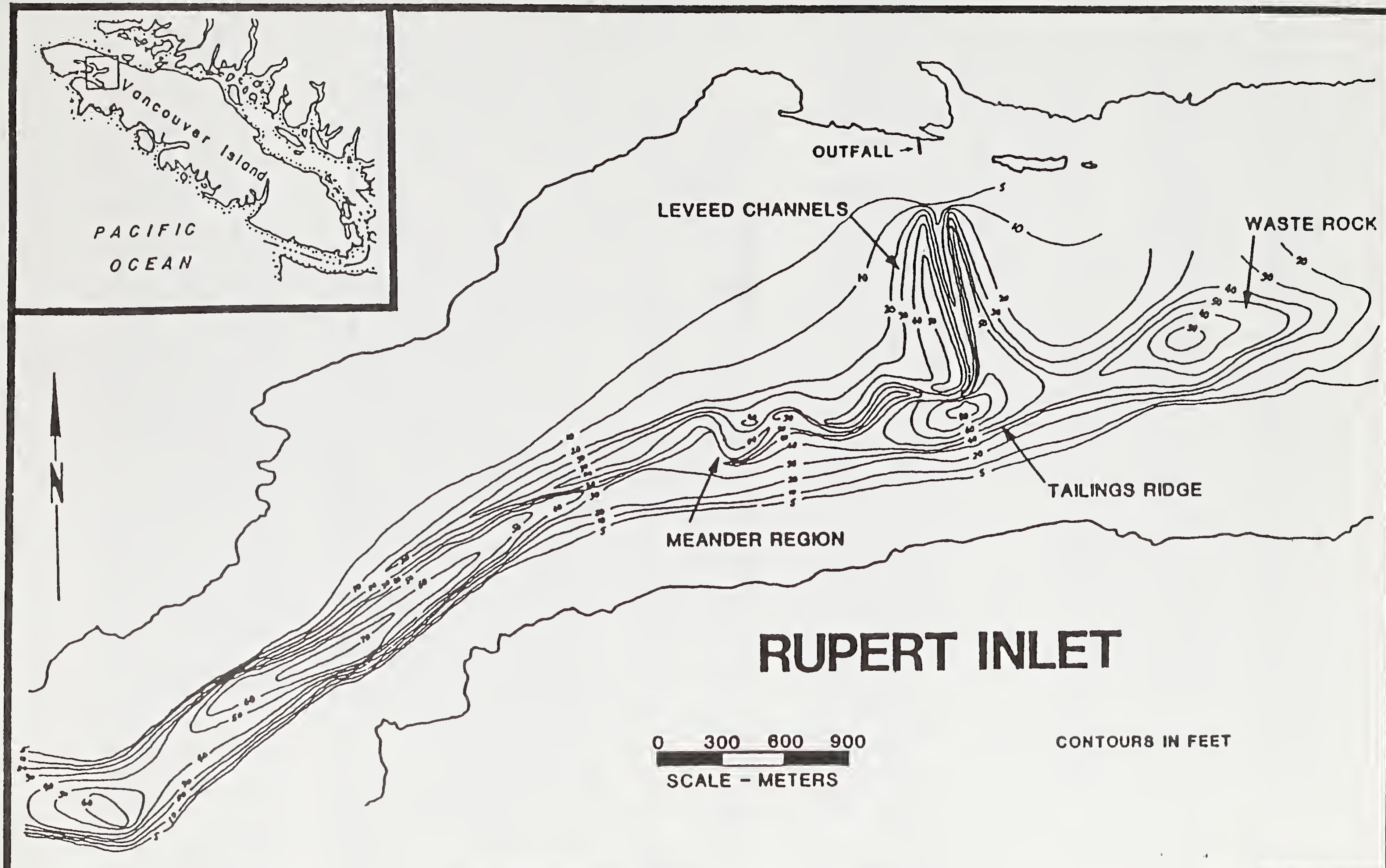
Tailings would continue to build up the bottom of the basin directly below the outfall. During the early phase of the project, deposition would be localized but rapidly changing over time. Meandering channels would form, directing the discharge along the path of least resistance. During the first few years of operation, half of the tailings would move upfjord and half of the tailings would move downfjord. The bottom of both fjords near the discharge is relatively flat. A ridge of tailings would form on the fjord bottom opposite the outfall, based on observations from the Rupert Inlet discharge (Figure 3-8). In time this ridge would wrap around the fjord bottom, upfjord of the outfall. Most of the tailings would then be directed downfjord. Until the tailings ridge becomes stable, slumping and transport of fines by currents or by diffusive processes would continue to move tailings upfjord.

As the ridge of tailings builds, the region of maximum deposition would move outward from below the outfall. As the slope of the ridge decreases, plume meandering and building of leveed channels would increase. When the channel deposits become unstable, the levees would collapse and the channel would shift laterally. The slumped material would continue downslope as a turbidity current. The longitudinal bottom slope may also become unstable and slump. Turbidity currents would carry coarser tailings material downslope, while episodic slumping would transport large quantities of material to greater depths. Many of these features are observed in the tailings disposal operation in Rupert Inlet (Findikakis 1983, p. 115).

<u>Characteristics Unique to Boca de Quadra Inner Basin Discharge</u>. The results of a feasibility study for a discharge located within the inner basin of Boca de Quadra gave the following unique characteristics for farfield behavior:

- In the early years of operation, virtually all of the tailings will be retained in the inner basin.

- After about 14 years of operation, the inner basin is full to critical slope and no further material accumulation can occur within the confines of the original inner basin. Therefore, any further addition



THICKNESS OF TAILINGS DEPOSITION IN RUPERT INLET IN JANUARY 1977

FIGURE 3-8

SOURCE: Findikakis 1983

of material to the inner basin must result from slumping along the density current channel between the outfall and the middle basin or advection of suspended solids from the middle basin.

- Future accumulations will progress down the middle basin toward the Kite Island sill, reaching depths of about 5 m (17 ft) at the base of the Kite Island sill at the termination of mine operations.

- Most of the deposits will be below 80 m (270 ft) in the inner basin and 150 m (500 ft) in the middle basin.

Deposition at the upfjord base of the inner sill would continue until the level of tailings nearly reaches the elevation of the top of the sill. Turbidity flows with sufficient momentum would be carried over the sill and into the middle basin. Deposition would continue to elevate the inner basin bottom until materials freely flow into the middle basin and the inner basin bottom slope becomes stable. A stable bottom slope is assumed to be 0.5 percent (U.S. Borax 1983b, p. C-1). Tailings flowing into the middle basin would form leveed channels and would be transported to the deepest part of the fjord.

Characteristics Unique to Boca de Quadra Middle Basin Discharge. The middle basin is largely symmetrical and relatively flat-floored when viewed in transverse sections. The basin floor beneath the proposed middle basin outfall site appears to have sufficient grade to maintain the coherence of the tailings density current leaving the outfall. The bottom slope at a depth of 100 m (330 ft; the end of the assumed near field) is approximately 5 percent (Ryan 1983, p. 23) instead of up to 50 percent as at the proposed outfall locations in the inner basin (Rescan Environmental Services 1984, pp. 65, 67). The basin floor slopes downfjord toward the Kite Island sill. The accumulated tailings at this depth should, therefore, progress quickly downfjord as a bottom density flow. The middle basin floor slope decreases approximately 4 km (2.4 mi) downstream, and some minor, low-relief irregularities are present. Tailings flow to this region is anticipated to fill in the irregular topography. Tailings deposits eventually will extend past this area and flow will continue downfjord, probably through a combination of turbidity currents and slumping.

Characteristics Unique to Smeaton Bay Discharge. Uncertainties about the equilibrium slope for tailings create concern about tailings flow in relation to the outer sill. Bounds on the equilibrium slope are slopes of 1:50 to 1:200. Studies in Rupert Inlet (Hay 1982, p. 139) showed deposits with a 1:30 slope near the discharge, a 1:60 slope a few kilometers from the discharge, and a 1:120 slope in lower reaches of the deposits. In Smeaton Bay, the outer sill is located approximately 14-15 km

(9 mi) from the outfall. A 1:50 slope extending 14 km would produce an elevation change of 280 m (990 ft); a 1:200 slope an elevation change of 70 m (240 ft). The 1:50 slope is of sufficient size that tailings would pile up at the outfall and backfill into Wilson Arm before (if ever) moving over the sill into Behm Canal. A 1:200 slope is just barely sufficient to ensure flow of tailings away from Wilson Arm and over the sill. A decrease in slope away from the outfall from 1:30-1:200 may result in blockage of the outfall before overspill into Behm Canal occurs. The deposition pattern of the tailings is a topic which must be continually examined during mining operations if discharge is made to Smeaton Bay.

The Fjord Circulation Models

These models were developed to learn about the interactions between the fjord circulation and suspended solids. The fate of tailings and the ecological effects of rapid sedimentation in a fjord are related to the water circulation in the fjord. A discussion of the model results follows the description of the oceanographic and meteorological conditions for each fjord.

Oceanographic and Meteorologic Conditions

Boca de Quadra

The general hydrography of Boca de Quadra has been described by Nebert (1983, 1984).

Circulation. The tide range in Boca de Quadra is from 2-6 m (6-20 ft). The dominant current in Boca de Quadra is due to the semidiurnal lunar tide. Currents can reach several knots in the vicinity of the Kite Island sill. None of the sills have a mud substrate, indicating that currents capable of eroding fine sediments occur frequently at these locations. The tidal currents are the most dynamic flows in the fjord; however, net transports of water are related to average flows over many tide cycles. The average currents are much smaller than peak tidal currents, making it difficult to infer mean circulation patterns from isolated observations of currents. Therefore, circulation patterns are inferred from observations of the water characteristics within the fjord.

Deepwater isolated from Revillagigedo Channel by the sills is replaced when water of sufficiently high density is available in Revillagigedo Channel at the depth of the outer sill. Generally this occurs each summer when northerly winds in the Gulf of Alaska cause coastal upwelling, which raises the nearshore pycnocline depth. This allows colder and more saline water to penetrate over the sill into Boca de Quadra. During winter

months, the prevailing southerly winds over the Gulf of Alaska deepen the nearshore pycnocline, inhibiting intrusion of dense water over the sill into Boca de Quadra.

A typical annual cycle for the fjord is characterized by a weak stratification of the deep waters of all three basins in winter. As summer approaches, dense (cold and saline) waters begin to rise in Revillagigedo Channel to the depth of the outer sill. When they reach sill depth, they flow over the sill into the outer basin where they replenish the less dense waters which existed at depth in this basin.

Deepwater renewal affects only the outer basin until the process has continued long enough to bring dense water to the more shallow Kite Island sill, which separates the middle and outer basins. Then dense water penetrates over this sill, replacing the deeper waters of the middle basin. Early in the renewal period, the waters entering the middle basin may not be dense enough to displace the bottom waters of this basin. The inflowing waters will seek their own density surface in the middle basin. As the season progresses, denser waters become available outside the Kite Island sill, and these waters will eventually be of sufficient density to replace the bottom waters of the middle basin.

Because the Kite Island sill is on a bend in the fjord, it complicates the current patterns. Kite Island is in the middle of this sill, so that the water flow over the sill is divided. On the southwest side of Kite Island is an east-west channel over the sill, and on the east is a north-south channel. There are strong net outflows above the sill in the channel on the southwest and strong net inflows through the deeper east channel. The flows in all of the channels reverse with changing tides. Thus, dense water can enter the middle basin through both channels on the flood tide. Non-tidal currents in the range of 50-100 cm/sec are common, and peak velocities are in the order of 120-140 cm/sec (Nebert 1984, p. 17).

Currents in the outer basin are complex. With the seven current meters that were deployed, it was not possible to account for the mass balance in the basin. Sill-depth currents are inward during the early phase of deepwater renewal since the waters at or just below sill depth are the first to be replaced during the renewal process. For the rest of the year, net flow at sill depth is outward. The deep waters show little net motion except during renewal events. These events take the form of a density current that sweeps down the inside slope of the Kite Island sill to a level where the incoming water is neutrally buoyant. Late in the deepwater renewal period, current episodes are seen at the bottom of the basin with peak current speeds that occasionally exceed 50 cm/sec (Nebert 1984, p. 33).

The inner sill, which separates the middle and inner basins, is deeper (110m [360 ft]) than both the outer and Kite Island sills. Thus, renewal of water in the inner basin begins shortly after dense water has overcome the Kite Island sill, even though the water may not be dense enough to penetrate to the bottom of the middle basin. The density of waters entering the inner basin increases with time until the cessation of the renewal process. Mass balance dictates that the volume of new water entering the basins must be compensated for by an outflow of less dense old waters (or old water mixed with the incoming water) above the penetration depth of the new water. The renewal process is not a slow, steady process; rather, it is a time-dependent process in which intrusions occur as the availability of dense water and tide conditions are appropriate.

Current meters have been deployed on the inner sill for different seasons and different water depths. Net currents near the surface tend to vary, but there are insufficient data to determine seasonal trends. From October-December, 1978, a net inflow at 14 m (46 ft) was observed even though this is a period of peak river runoff. In January-February, 1979, the net currents were toward the middle basin. In contrast, a seasonal pattern has been seen in the near-bottom currents. From October-April there is a persistent net outflow. The remainder of the year there is a weaker but also persistent net inflow. The reversals in the flow directions appear to coincide with the onset and cessation of the renewal process. The inflows and outflows occur in the lowest 15 m (48 ft) of the water column above the sill. No net flows have been observed by current meters in the middle water column.

Currents within the inner basin are generally weak and variable, but there are times when bottom currents show a well-developed outflow which coincides with outflow over the inner sill. The observations are not sufficient to understand the connections and causes for the correlation of the bottom and sill currents. Inflowing currents are also observed near the bottom, coinciding with renewal events in the middle basin. The highest speed observed in the inner basin by a near-bottom current meter was less than 15 cm/sec (Nebert 1983, Appendix D). The mid-depth waters of the inner basin are relatively stagnant.

The outer basin remains in good contact with the waters of Revillagigedo Channel and has a continual renewal of near-surface waters throughout the year. Time series salinity and temperature data from the outer basin strongly suggest that the deep waters are also in good communication with the adjacent channel. The outer basin deep waters tend to be well mixed vertically, which suggests the bottom waters are being renewed throughout the year (Nebert, 1985b). During the fall, the waters entering from the Channel into the outer basin are warmer and of lower salinity than the waters in Boca de Quadra. This near-

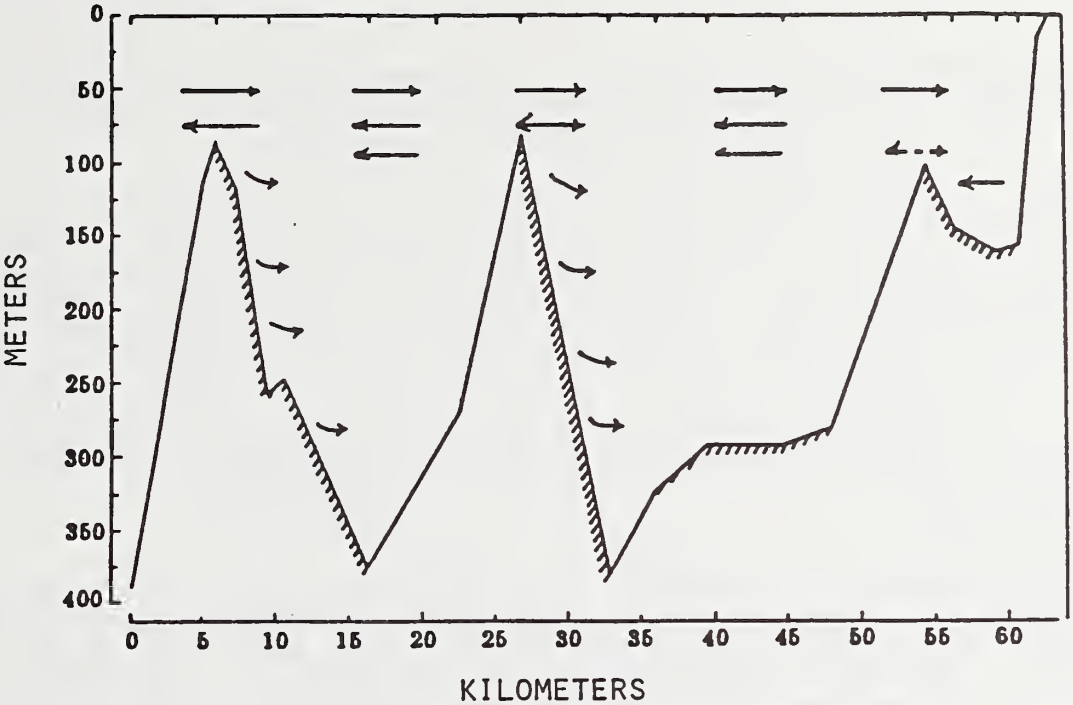
surface intrusion of water penetrates the length of Boca de Quadra and is a distinct hydrographic feature at the head of the fjord throughout the winter.

During the winter, the exchange process reverses direction as the below-sill waters within Boca de Quadra are now denser than the waters at the depth of the outer sill in Revillagigedo Channel. Mixing of the dense waters in the basins with lighter sill-depth waters generates sill-depth outflows. Throughout the winter, the basin waters slowly diminish in density as a result of mixing processes, preparing the basins for the next summer's renewal events.

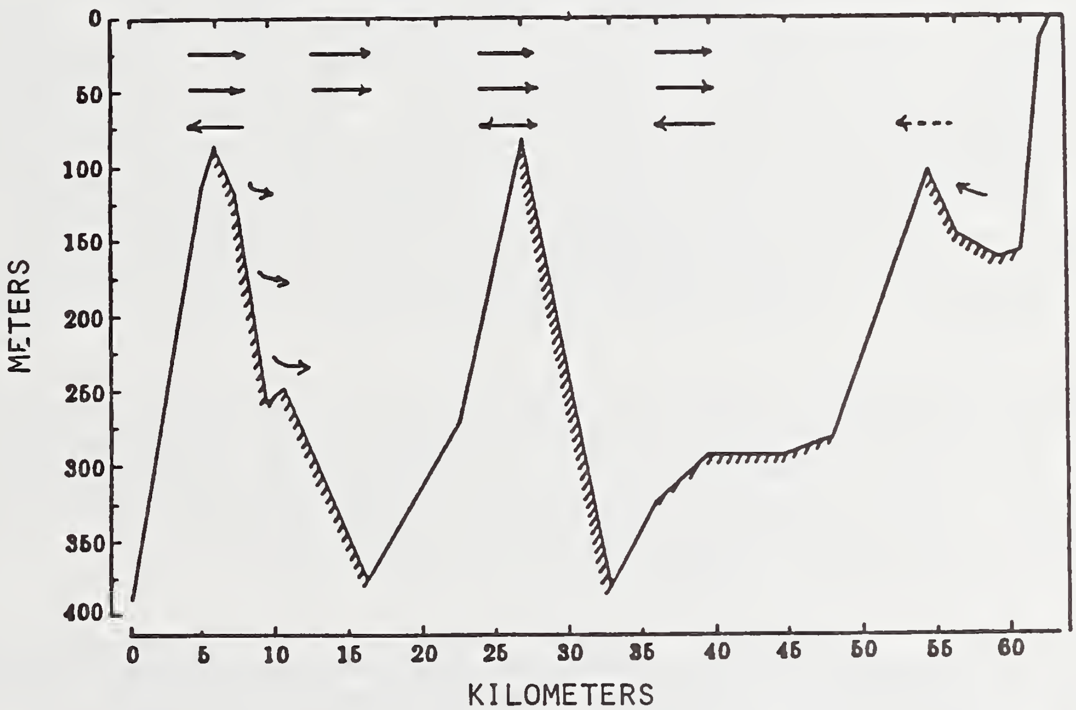
The annual progression of water mass replenishment and mixing within Boca de Quadra fjord will vary in timing and intensity in different years. Deepwater renewal never fully developed in the middle basin in 1983; no deepwater renewal was seen below 150 m (500 ft) (Nebert 1984, p. 25). This was a year with weak upwelling of coastal Alaskan and British Columbia waters. Without deepwater renewal, densities in the middle basin will be relatively low at the beginning of the winter isolation period. Continual downward mixing of the overlying waters will further reduce densities. At the beginning of the following deepwater renewal period, stratification in the middle and inner basins will be exceptionally weak. When the renewal starts early, there is no reason to expect the intrusions are more likely to penetrate to the bottom than during "normal" years. It is likely that the intrusion will start earlier and will last longer than if the summer renewal is normal and the basin waters started with below normal density (Nebert, 1985b).

Generalized circulation features for the deepwater renewal and non-deepwater-renewal periods are shown in Figure 3-9. The features presented in this figure are schematic and cannot be interpreted as the flow at any given time. Dashed lines are used where the mean circulation is expected to be highly variable.

Except for the short period of time when dense waters move upfjord at sill depth, Boca de Quadra circulation is unlike that of the classical fjord. Temperature and salinity observations indicate a pattern of upper level inflow and sill depth outflow over much of the year. Nebert (1984) suggested that the freshwater inflow to the fjord is too small relative to the tidal flow to drive a circulation typical of most fjords. The tide flow is measured by the tidal prism, which is the volume of water needed to fill the fjord during the rise of the tide. In Boca de Quadra, the yearly mean of the ratio of freshwater inflow to the tidal prism is 0.005. Even in periods of high freshwater inflow (October), the ratio is only 0.018. The driving force for upper water circulation is thought to be brackish water derived from coastal British Columbia. This water moves northward up



GENERALIZED CURRENT PATTERN DURING DEEPWATER RENEWAL PERIOD



GENERALIZED CURRENT PATTERN DURING NON-DEEPWATER RENEWAL PERIOD

CURRENT PATTERNS IN BOCA DE QUADRA

FIGURE 3-9

SOURCE: Envirosphere 1984, p. 3-42

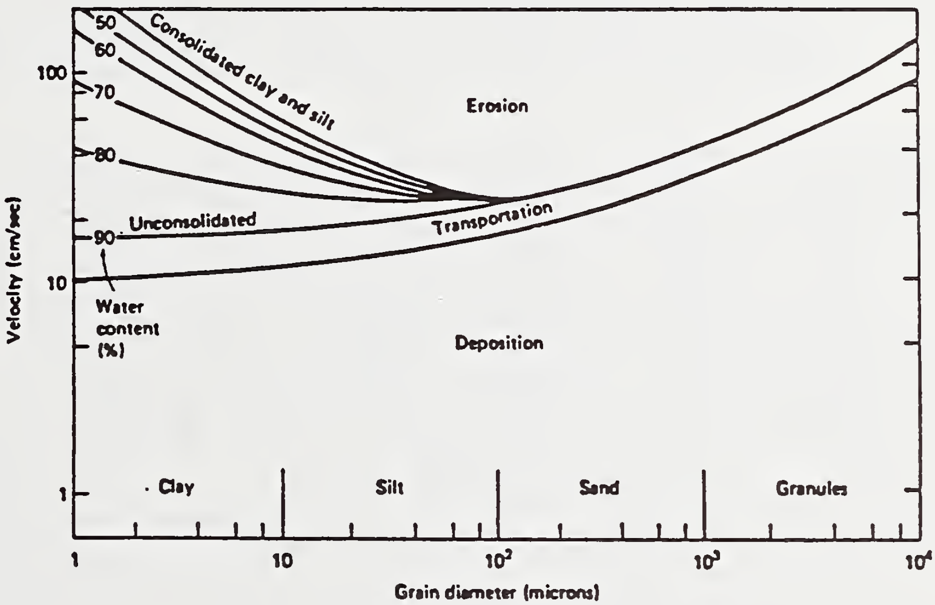
Revillagigedo Channel to the mouth of Boca de Quadra. Upon entering the fjord, these surface waters respond to freshwater input, winds, and along-fjord density differences.

Under normal conditions, the upper 100 m (330 ft) of the water column has the largest vertical density gradients. Local processes such as solar heating and fresh water inflow, together with deepwater renewal events, strengthen the density gradient in the upper water column. The summer pycnocline at depths of 40-100 m (130-330 ft) strongly resists any upward movement of basin waters in the surface layers. Stratification is highest in August and September (Nebert 1983, p. 9). During the winter, the intrusion of warm and fresh water from Revillagigedo Channel maintains a weaker but still significant upper-layer stratification.

Some changes in the dynamics of the fjord circulation in the inner basin are expected after this basin has been filled with tailings. There would no longer be a storage basin for dense water and, therefore, the net outflows observed at sill depths during the winter would not exist. Furthermore, without the net flows driven by density variations associated with renewal and mixing of renewed water, there remain only three sources of energy to drive a circulation: runoff, winds, and tidal action. Accordingly, wind-driven circulation patterns would become more important than at present. An example of the kinds of current patterns that might result can be found in East Sound in the San Juan Islands of Washington State. Although it has little runoff and is shallower than the filled inner basin, it has surface dimensions similar to the inner basin and lacks a basin. The wind-driven circulation in this system has been discussed by Rattray (1967). In this fjord-like embayment, the surface wind-driven transport of water was compensated for by mid water column reverse flows.

Bottom Currents. Bottom currents are of particular interest in Boca de Quadra because of their potential for resuspending and redistributing tailings deposits. The transport, deposition, and erosion of tailings solids depend on current velocity, particle grain size, and the degree of deposit consolidation. This relation is presented graphically in Figure 3-10.

Fine sediments are not found in regions where there are frequent (i.e., monthly) currents capable of eroding fines. Thus, there is a tendency to find sands and gravels over sills. Mill tailings, like natural sediments, will not occur in large accumulations in such regions; therefore, these areas will not experience major slumpages that result in the injection of large quantities of fines into the overlying water column. Bottom current can cause significant resuspension, however, if there are



Note: Velocity measured 15 cm above the bottom. Note effects of consolidation upon commencement of erosion in clays and silts.

BOTTOM CURRENT VELOCITIES (CM/SEC) REQUIRED FOR EROSION, TRANSPORTATION, AND SEDIMENTATION ACCORDING TO SEDIMENT GRAIN SIZE

FIGURE 3-10

SOURCE: Kennet 1982, p. 517

fringe areas of the sills where the occasional (i.e., less frequent than monthly) strong bottom current encounters a normally placid deposition area.

High currents near the bottom are expected when a stratified fluid flows over sills during the tide cycle. There is a tendency for a wave-like flow in the lee of the sill, with dense water that flows over the sill penetrating the water column behind the sill to greater than its neutral buoyancy depth. However, the deep downward flow and subsequent rise of the strong deep currents does not extend great distances (more than several km) in the lee of sills. Although specific details are lacking, the observations of deep currents in Boca de Quadra fit this general picture. With just the right conditions, it is possible that a strong bottom flow could disrupt what is ordinarily a more tranquil tailings deposition zone.

Table 3-4 lists the velocities required to erode bed sediments for different sediment sizes and consolidations. The cumulative percentage of the Quartz Hill tailings as a function of particle diameter (Figure 2-4) is given in the left-hand column. The surface layer of deposited tailings is expected to be relatively unconsolidated and have a water content of at least 50 percent by weight. For the median sized particle (63 um) and deposits that are 50 percent consolidated by water content, current velocities of 23 cm/sec or greater would erode and transport the tailings. Currents in excess of 20 cm/sec create the potential for erosion of sediments for a wide range of particle sizes and bed conditions. The currents shown in Figure 3-10 and listed in Table 3-4 are the values needed at 15 cm above the sea floor for erosion. Currents measured further from the sea bed would need to be larger. For currents 1 m (3 ft) off the sea floor, the proportional factor would be between 1.2 and 1.5, depending on assumptions about the nature of the boundary layer.

Near-bottom measurements of currents have been made at a number of locations in Boca de Quadra during 1982. The bottom current meter data have some inherent limitations. The primary purpose of the arrays was to collect information on water movements in the fjord, and not to study erosion. Reported measurements are usually the average values of current over periods of 15-30 minutes; it is possible to have high frequency events that exceed threshold while average currents are smaller than required for erosion. Furthermore, the current meters on the arrays were usually 2.5 or 10 m above the bottom, making it difficult to assess shear forces on sediments. Finally, the bottom coverage by current meters is sparse; thus, many important events could be missed. Because bottom currents are not uniform across or along a fjord, observations of bottom currents with a limited array of current meters provide only a potential indication of strong bottom current events. The interpretation as to cause of strong bottom current events is extremely

Table 3-4. Current Velocities Required to Erode Bed Sediments

CUMULATIVE PERCENT[a] (%)	PARTICLE DIAMETER (um)	VELOCITY (cm/sec)[a]			
		V_{90}	V_{70}	V_{50}	V_o
11	5	17	45	75	260
18	10	18	37	60	160
30	21	19	28	35	110
38	35	20	25	30	80
47	52	21	24	25	70
55	74	22	23	23	60
64	90	22	23	23	50
72	110	23	23	23	50
80	140	23	23	23	50
88	180	24	24	24	50
90	200	26	26	26	50

[a] From Figure 2-4.

[b] V_{90}, V_{70}, etc. = velocity required to erode bed sediment particles having 90 percent water content by weight, 70 percent water content, etc. From Figure 3-10.

difficult with limited current data. Nevertheless, the data are useful in assessing the erosion and suspension potential of certain areas.

Bottom current velocities exceeding 20 cm/sec have been observed in several locations in Boca de Quadra. Most of these currents are associated with the Kite Island sill during strong tides; however, bottom currents exceeding 20 cm/sec have been observed elsewhere in the middle basin during deepwater renewal in summer and early fall. During this period, density flows moved down the upfjord escarpment of the Kite Island sill and extended to the deepest point of the middle basin. On the escarpments, currents substantially higher than 61 cm/sec were recorded by Nebert (Rescan Environmental Services 1984, p. 24 and Nebert, 1985b). This event was not observed 2 km further into the fjord.

During renewal of the middle basin deepwater, currents across the inner sill into the inner basin often exceeded 20 cm/sec. Density gradients across the inner sill, which form during the renewal period, appear to augment the flood tide, causing larger-than-average near-bottom currents. The presence of a density flow across this sill is supported by bathymetric data which show a narrow, V-shaped channel on the upfjord side of the inner sill. The channel leads down the escarpment to a depression on the inner basin floor. Note that once the inner basin has filled with tailings these density currents will not arise. Nebert (1985b) maintains that insufficient study has been directed to the existing data for the inner sill and the inner basin to draw any firm conclusions about what is occurring there.

Although the current velocity maxima across the inner sill generally coincide with middle basin bottomwater replacement, the occurrences span a greater time period during the year. This is expected because the intrusion depth of waters entering the middle basin across the Kite Island sill changes slowly during the beginning and end of deepwater renewal. This would prolong the density gradient across the inner sill, resulting in density flows occurring before and after those noted at the bottom of the middle basin (Rescan Environmental Services 1984). The actual details of how the density differences arise must be complex, since during a normal year of deepwater renewal both the middle and inner basins receive more than a basin of "new" water (Nebert 1984, p. 25). Bottom currents in the inner basin appear to be small. This suggests that the density flows disperse soon after entering the inner basin.

This interpretation of the current meter data is supported by sediment core data. Generally coarse sands are associated with the sill regions, with a gradation to silts and clays moving away from the sills. The inner and middle basin floors consist primarily of clay-sized particles.

As the inner basin fills, it is possible that there will be a time when bottom currents exist in the lee of the sill that are strong enough to erode deposited tailings. If this were to happen, there would be a major source of suspended materials near sill depth that would exceed the background levels of suspended particulates created as a result of tailings discharge and slumping. However, the magnitude and duration of this event would decrease as below-sill volume in the inner basin decreases.

The farfield model for tailings does not predict a large accumulation of tailings at the foot of the Kite Island sill. Thus, the amount of material available for resuspension is less than at the inner sill. Even if the model underestimates accumulation by a large factor, there still would not be accumulations reaching up the escarpment to any significant distance. Thus, although there may be large bottom currents in the lee of the Kite Island sill for the duration of the discharge, they are not likely to cause significant elevation of suspended solids in waters above sill depth because the vertical distance is so great.

Winds. Winds were measured 24 February - 10 June 1983 and 21 July - 21 October 1983 at a central location in the fjord near the inner sill (Johnson 1984). The observations taken during the first time period show that the most common wind directions were downfjord. The second most common directions were winds upfjord. About 80 percent of the time, wind speeds were in the range of 1-6 m/sec (2-12 knots). The strongest winds observed came downfjord and were less than 12 m/sec (24 knots). These winds are expected to occur infrequently since only one storm event occurred with sustained winds of 11 m/sec (22 knots) during the observation period.

Observations taken during the second observation period (summer conditions) show the same direction pattern, with winds tending to be either upfjord or downfjord. Winds were weaker during this season with no observations of winds exceeding 10 m/sec (20 knots).

Winds do not appear to have a major effect on the present circulation in Boca de Quadra. No obvious wind-mixed layer has been observed in the STD profiles, nor have wind-induced currents near the surface been reported. Upwelling, therefore, has not been demonstrated by the existing data. However, the shallowest current meters have been at a 15 m depth and could miss a thin surface-layer flow.

Pycnocline Depths. The pycnocline is the depth where the greatest change in water density occurs with the least change in depth. Vertical exchanges of materials across such density boundaries are greatly reduced because energy must be used to overcome the differences in fluid weights.

Nebert (1984) illustrates profiles of the vertical distribution of density at a station approximately in the middle of the main basin. The depths of the pycnocline in Table 3-5 are derived from these profiles. The depths indicate the approximate transition between more or less homogeneous deep waters and surface waters.

<u>The Fjord Model</u>. A model of Boca de Quadra fjord circulation was developed by Kowalik (1984) in order to investigate suspended sediments and their spatial distribution in the fjord. Because the natural diffusion rates of sediments within the water column are low, it takes months to reach "equilibrium" conditions. The fjord circulation patterns changes in time scales of months; consequently, there may never be a steady-state suspended distribution of sediments due to mill tailings. Because of the long times involved, the model must average over independent events and extremes, yet be faithful to long-term trends.

To meet these objectives, Boca de Quadra was simulated by its average cross-channel conditions, its vertical structure, and the water masses at its extrema that drive the circulation. Winds were not included in the circulation model. It cannot be expected that models constructed within these constraints will be accurate in detail; rather, their purpose is to detect general trends and compare general trends with assumptions.

All numerical models need to be calibrated against some measurements. The calculated salinity distribution was evaluated relative to observations, and model parameters were adjusted to produce best fits. With these model parameters, distributions of fine particulates could be simulated. Because winter observations were too sparse, no meaningful model of winter conditions could be derived. The pycnocline tends to be deeper in winter, which both hinders intrusions of fines towards the surface water from deep slumpages and, at the same time, makes it easier for suspended sediments created in shallower waters to get into and remain in the surface waters. A discharge directly to the middle basin of Boca de Quadra would minimize the chance of suspended sediments getting into the upper water column during winter months because the major sources of turbidity (slumping and perhaps resuspension under certain conditions) would occur at greater depths.

Model simulations (Kowalik 1984) were reported for four conditions:

1) A density-driven flow (summer conditions) and a source of tailings distributed along the bottom from the inner sill to the deepest part of the middle basin.

Table 3-5. Pycnocline Depths in Boca de Quadra

DATE	PYCNOCLINE DEPTH[a]
August 82	50 m
October 82	100 m
November 82	130 m (not a sharp pycnocline)
December 82	130 m
January 83	140 m
January 83	140 m
March 83	140 m
April 83	160 m (weak gradient above pycnocline)
June 83	50 m
June 83	30 m
July 83	50 m
October 83	80 m

[a] These depths give the lower end of the strongest gradient.

SOURCE: Nebert 1984

2) A density- and tidally-driven flow (summer conditions) and a source of tailings distributed along the bottom from the inner sill to the deepest part of the middle basin.

3) A density- and tidally-driven flow (summer conditions) and a source of tailings distributed along the bottom of the inner basin.

4) A density- and tidally-driven flow (summer conditions) in a fjord whose geometry is that anticipated of Boca de Quadra after 55 years of discharge to the middle basin. The source of tailings was distributed along the bottom from the inner sill to the deepest part of the middle basin.

In the discussion, contours of 50, 10, 1, and 0.1 percent of the bottom concentration of suspended particulates are illustrated. The model predictions reflect temporally and spatially average concentrations across the fjord, and not episodic events such as slumping or localized high concentrations such as those above turbidity flows (Figure 3-7). As shown in Figure 3-7, sediment concentrations near the bottom range from 200-2,000 mg/l at a distance of 1,000 m (3,300 ft) from the outfall. Using a value of 600 mg/l, for example, the contours would correspond to concentrations of 300, 60, 6, and 0.6 mg/l.

In general, natural surface sediment concentrations of particulate matter do not exceed 1-2 mg/l except for periods of high river discharge (Burrell 1983, p. 3-10). Below-sill-depth particulate concentrations are nearly uniform throughout the year with values of about 0.3 mg/l.

The simulations of suspended sediment concentrations are similar for model runs 1 and 2. Both show concentrations of 50 percent reaching upward to depths of about 110 m (360 ft) over the inner half of the middle basin and entirely over the inner basin after 82 days of operation. The inner sill in the circulation model is at a depth of 130 m (430 ft) rather than 110 m (Table 3-1), thus this level of suspended sediment concentration is predicted to exist at about the depth of the inner sill. Both simulations indicate that any material passing over the Kite Island sill would have concentrations in the 1-0.1 percent range.

In the third simulation the source of the tailings was confined to the inner basin. In this case, the model indicated that virtually all concentrations above 0.1 percent of the suspended material stayed above the inner basin. Any suspended material leaving to the outer basin would have sediment concentrations at natural background levels. The model predicts little circulation within the inner basin, which is why the

sediments are not advected away from their source. The model predicts weak inflowing velocities to the inner basins at sill depth and a stagnant water layer above the inner sill at depths between 50-90 m (160-290 ft). Outflow of water occurs in a thin layer between 30-50 m (100-160 ft) deep. Settling velocities for suspended sediments were less than 0.01 cm/sec in the numerical calculations, yet these small velocities must be sufficient to prevent suspended particulates from reaching the depth of the outflowing waters from the inner basins.

The fourth simulation indicates suspended sediment concentrations similar to the first two experiments.

The model does not include tidal currents. In the middle and outer basins, tide currents will not have a large effect on the distribution of properties predicted by the numerical model because the horizontal changes in the properties are small when compared with the semidiurnal tidal excursions. The calculations indicate large gradients of suspended particulates across the inner sill. The effect of tides would be to smooth such gradients and promote sediment flux into the middle basin. In the absence of mixing, the effect of tidal excursions will be only a periodic displacement of material. Mixing, added to the tide displacement, results in a flux of material in the direction of decreased concentrations. The magnitude of this flux will be small compared to the advective currents used in the model in the middle and outer basins where gradients of suspended sediments are small. Over the inner sill, however, the mechanism could dominate model currents. Cross-channel variations in tidal currents and mean flows could also add to dispersion of suspended materials. For these reasons, the numerical model may be underestimating dispersal of suspended sediments. The Kowalik (1984) report does not specify the value for horizontal diffusivity that was used in the calculations or whether it was constant at all locations in the fjord. It might be necessary to assume different horizontal diffusivities over the sills and within the basins.

In an effort to re-examine the concentration of suspended solids and the rise of a turbid plume in Boca de Quadra, Findikakis and Ryan (pers. comm.) provided rough calculations to U.S. Borax. The calculations, however, must be interpreted broadly because they assume a quiescent environment and a freshwater plume. Both factors would result in higher plume rises than expected in Boca de Quadra. The calculations indicate the highest point at which vertical velocity goes to zero will occur at the inner sill at about 10 m (33 ft) below the water surface. High rises were also noted for stations in the inner basin. In contrast, the maximum rise in the middle basin was to a depth of 100 m (330 ft).

Smeaton Bay

Circulation. The general hydrographic features of Smeaton Bay have been described by Nebert (1985). There was less analysis of the data for Smeaton Bay than Boca de Quadra and there has been less interpretation of the information than for Boca de Quadra. It is, therefore, not possible to be as specific, particularly with regard to current meter observations. Because there is only one sill isolating Smeaton Bay from coastal waters, the bay's annual water circulation cycle is likely to be simpler than Boca de Quadra's. Data limitations include inability to address cross-channel variability, annual variability, and vertical movements of currents. The mass balance between observed flows near the surface and flows at depth near the head of Wilson Arm cannot be accounted for with existing data.

The tide range in the fjord is from 5-7 m (16-23 ft). The dominant current in Smeaton Bay is caused by the semidiurnal lunar tide. Currents can reach 1 knot in the vicinity of the outer sill. The tidal currents are the most dynamic flows in the fjord; however, net transports of water are related to average flows over many tide cycles. The average currents are much smaller than peak tidal currents, making it difficult to infer mean circulation patterns from isolated observations of currents. Therefore, circulation patterns are inferred from observations of water characteristics within the fjord.

Deep waters are replenished in Smeaton Bay during about a 6 month period. This contrasts with the middle and inner basins of Boca de Quadra, where replenishment takes place during a period of 3-4 months. The difference in duration of replenishment is due to the deeper sill at the mouth of Smeaton Bay which allows deep water renewal to begin earlier (as the pycnocline rises) and last longer. The process of deepwater renewal is similar to that of Boca de Quadra. A typical annual cycle for the fjord is characterized by a weak stratification of the deep waters in the basins in winter. As summer approaches, dense (cold and saline) waters begin to rise in Behm Canal to the depth of the outer sill. When they reach sill depth, they flow over the sill at flood tide and replenish the less dense waters which existed at depth.

Influx at sill depth of denser water from Behm Canal with the flood tides produces density currents over the sill and upfjord along the bottom of Smeaton Bay, uplifting the deep water and driving the outflow. This third layer in the current scheme usually persists from May until late September when coastal downwelling commences and the influx at sill depth ceases. Current velocities of 30-60 cm/sec are common at the sill, with peak velocities exceeding this (Nebert 1985, p. 26). Deep

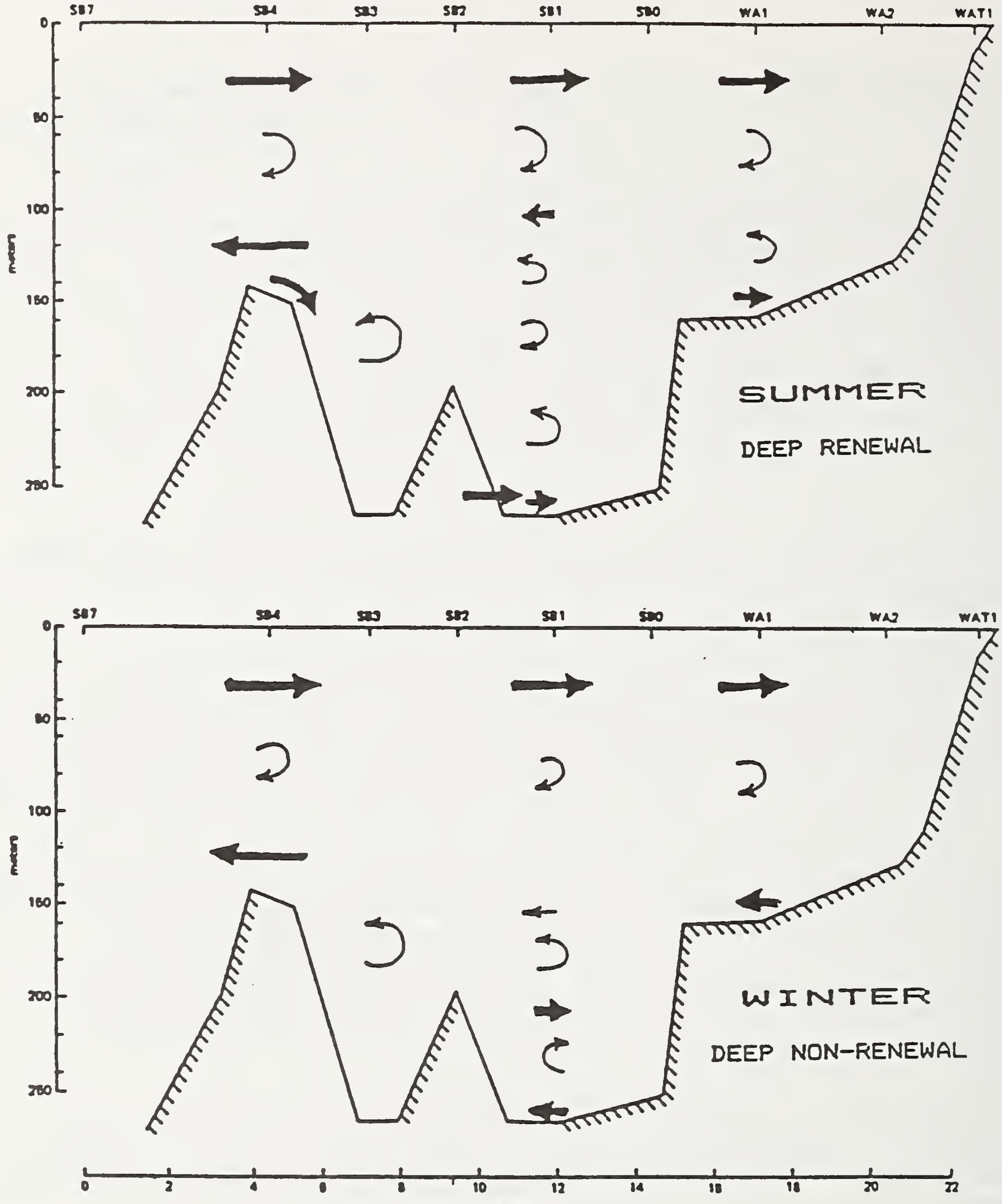
outflow velocities are higher than near surface inflow because the V-shape fjord constricts the outflow to a small cross-sectional area, increasing speeds.

Smeaton Bay exhibits a continual inflow of near-surface waters throughout the year. During the winter, the waters entering from Behm Canal into the fjord are warmer and of lower salinity than the waters in Smeaton Bay. Assisted by processes of horizontal advection, this surface intrusion penetrates the entire length of Smeaton Bay and remains a distinct feature at the head of the fjord in Wilson Arm throughout the winter. Surface inflow from the Wilson and Blossom Rivers produces a shallow stratification, helping to insulate the warmer waters below from vertical mixing. This feature disappears in the summer.

Generalized circulation features for the deepwater renewal and non-deepwater-renewal periods are shown in Figure 3-11. The features presented in this figure are schematic and cannot be interpreted as the flow at any given time.

The circulation in Smeaton Bay is unlike that of the classical fjord. Temperature and salinity observations indicate a pattern of upper-level inflow and sill-depth outlow over much of the year. Nebert (1984) suggested that freshwater inflow to the fjord is too small relative to the tidal flow to drive a circulation typical of most fjords. The tide flow is measured by the tidal prism, which is the volume of water needed to fill the fjord during the rise of the tide. Freshwater inflow is probably less than 5 percent of the tidal prism even during high discharge episodes. The driving force for upper-water circulation is thought to be brackish water derived from coastal British Columbia. This water moves northward up Behm Canal to the mouth of Smeaton Bay. Upon entering the fjord, these surface waters respond to freshwater input, winds, and along-fjord density differences.

Under normal conditions, the upper 100 m (330 ft) of the water column has the largest vertical density gradient. Local processes such as solar heating and fresh water inflow, together with deepwater renewal events, strengthen the density gradient in the upper water column. The summer pycnocline at depths of 60-100 m (200-330 ft) will strongly resist any upward movement of basin waters into the surface layers. Stratification is highest in August and September (Nebert 1983, p. 9). During the winter, the intrusion of warm and fresh water from Behm Canal usually maintains a weaker but still significant upper-layer stratification.



Note: Bold arrows are supported by measurement; light arrows are surmised.

CURRENT PATTERNS IN SMEATON BAY

FIGURE 3-11

SOURCE: Nebert 1985, p. 60

Bottom Currents. Bottom currents are of particular interest in Smeaton Bay because of their potential for resuspending and redistributing tailings deposits. The important factors are the same as for Boca de Quadra.

As anticipated from previous studies in Boca de Quadra, strong currents have been found at the entrance sill. Tidal currents often have speeds in the 20-50 cm/sec range at sill depth and above. There is a tendency for higher peak currents during the summer-fall period. Because of frequent high velocities, the sill is likely to remain clean of fine-grained sediments.

Bottom current velocities exceeding 20 cm/sec have been observed in several locations in Smeaton Bay. Most of these currents are associated with the sills during strong tides; however, high bottom currents have been observed in the basin during deepwater renewal periods. During these periods, density flows moved down the upfjord escarpment of the outer sill and extended into the basin. On the escarpment, currents in excess of 30 cm/sec were recorded by Nebert (1985, p.59).

During the deepwater renewal period, inflowing currents of 10-30 cm/sec were observed (Nebert 1985, p. 59) on the inner slope of the sill at a depth of 185 m (600 ft). During the initial years of discharge, such currents would not be of much concern. However, during later years of mine operations, when tailings deposits have begun to encroach on the sill escarpment, the bottom currents could inhibit accumulation of tailings and increase suspended sediment concentrations in the overlying water column. During deepwater renewal, currents on the upfjord escarpment of the minor sill 6 km upfjord were in excess of 30 cm/sec with maxima to 45 cm/sec (Nebert 1985, p. 27). Current peaks attributed to renewal inflow during flood tide at the minor sill lagged 10-11 hrs behind events at the outer sill. Average bottom velocities for renewal inflow propagation between sills along the bottom of the fjord would need to be at least 15 cm/sec. The slight constriction at the minor sill is the probable cause for increases in speed at the sill over the upfjord propagation speed, since the deep sill depth has not been shown to generate any density gradient between sub-basins on either side.

Bottom currents in Wilson Arm were only measured over one winter season; however, the beginning and end of the deepwater renewal period is apparently included. The flow is primarily downfjord in winter with speeds in excess of 20 cm/sec and peaks to 40 cm/sec (Nebert 1985, p. 18). Limited data were collected during the summer renewal period although indications are that flow is primarily upfjord. Upfjord current speeds, although critical in deposition/resuspension of tailings and plume

behavior in Wilson Arm, are speculative. The causes of these observations are not known, so it is uncertain what impact filling the basin with tailings will have on currents.

Winds. Wind records for the Smeaton Bay fjord system are limited to an 8 month record taken during the winter of 1980-1981. The winds were seldom in excess of 5 m/sec (10 knots) in the upfjord direction. The winds frequently exceeded 10 m/sec (20 knots) in the downfjord direction.

During winter, the dominant wind direction is downfjord, and most strong wind events last less than one to a few days. Two prolonged, distinct events (longer than a week) were observed during December 1980, however. The frequency of downfjord winds appears to moderate and switch to weaker upfjord winds in May. Since May was the end of the record, no general conclusions may be drawn concerning summer winds.

In spite of the downfjord winds during winter, the upper water column current meters deployed in the fjord suggest that an upfjord net flow is prevalent. The upper water column current measurements were made from depths of 13 m (40 ft) and deeper; therefore, it is possible that they would miss a wind-driven surface circulation. The data suggest that upwelling is not likely, but the data to verify this (particularly during deepwater renewal in summer) are not available.

Pycnocline Depths. Nebert (1985) illustrates profiles of the vertical distribution of density at a station approximately in the middle of the main basin. The depths of the pycnocline in Table 3-6 are derived from these profiles. Table 3-6 indicates the approximate depth of the transition between more or less homogeneous deep waters and surface waters.

The Fjord Model. A model of fjord circulation was developed by Kowalik (1984) and adapted to Smeaton Bay by Kowalik and Findikakis (1985) in order to investigate suspended sediments and their spatial distribution in the fjord. Model limitations are the same as noted for Boca de Quadra.

Model simulations were reported for the following conditions:

- o The fjord circulation model was run for the 96-day period from 11 June - 15 September 1981. This is the time period for which there is the best field information.

- o The model was used for two cases: density-driven circulation and density-driven plus tidal inflow at the outer sill. The density-driven case with tides resulted in the closest agreement to field data for salinity distributions. Predicted near-surface

Table 3-6. Pycnocline Depths in Smeaton Bay

DATE	PYCNOCLINE[a]
October 79	115 m
November 79	100 m
December 79	180 m (uniform weak gradient above)
March 80	125 m (weak pycnocline)
June 80	100 m
August 80	90 m
September 80	100 m
October 80	125 m
November 80	130 m
December 80	175 m and 130 m
February 81	150 m
March 81	? (no distinct pycnocline)
April 81	100 m
May 81	100 m
June 81	100 m
July 81	90 m
August 81	60 m
September 81	120 m

[a] These depths give the lower end of the strongest gradient.

SOURCE: Nebert 1985

salinity distributions. Predicted near-surface salinity concentrations for Smeaton Bay are improved over those obtained for Boca de Quadra, which were somewhat lower than observations.

- The model was run to simulate a source of suspended fines from a density current created by a discharge at the head of the fjord in Wilson Arm. The source concentration was distributed between the outfall and the downfjord end of the deep sub-basin existing at the junction of Wilson and Bakewell Arms.

Percentage contours for suspended particulate concentrations were as noted for Boca de Quadra, i.e., 50, 10, 1, and 0.1 percent of the bottom concentration.

The model predicted average, cross-fjord 0.1 to 1 percent concentration contours reaching to 60 m (200 ft) below the surface, i.e., 0.6 - 6.0 mg/l for assumed bottom concentrations of 600 mg/l of less than 10 um particles. The model predictions reflect temporally and spatially averaged concentrations, and not episodic events such as slumping or localized high concentrations such as those above turbidity flows (Figure 3-7). Concentrations reached a peak at about 80 days into the model run, after which the plume began to recede slightly back toward the bottom, evidently as a result of changes in deepwater renewal. The modeling effort by EPA (1988) suggests winter concentrations in Smeaton Bay near the end of the project as high as 12 mg/l at a depth of 60 m.

The Kowalik and Findikakis (1985) model predicts outward transport of fines across the outer sill into Behm Canal during the entire simulation period. The concentration of the exiting plume is 6-60 mg/l based on bottom fines concentration of 600 mg/l, respectively. This outflow of sediments occurs with the waters that flow out to compensate for the water filling the deep basin.

Energy Considerations

Vertical transport of suspended materials into the upper water column is significantly influenced by the density of water at various depths. Strong density gradients require large amounts of energy to be overcome compared to weak density gradients. The amount of energy necessary to transport more dense deep water to less dense surface water can be used to compare the probabilities of vertical movement of suspended fines.

Jones & Stokes Associates (1988) obtained oceanographic and meteorological data collected in Boca de Quadra and Smeaton Bay by the University of Alaska Institute of Marine Sciences.

Salinity, temperature, and density (STD) data were used to compare the two fjord systems with respect to the amount of work required to bring water of a density equal to that of the bottom (or near-bottom) water to a depth of 50 m. A reference level of 50 m was chosen in order to minimize the effects of wind-generated stress on water transport. It is assumed that particulates that reach as high as 50 m are likely to penetrate higher into the water column because of the mixing in this upper surface layer. This work is a measure of the energy required by fluid turbulence to bring bottom water, and its suspended fines, to the near-surface waters. The measure of energy is unaffected by internal waves because they only alter the vertical location of a density surface and hence have less statistical fluctuation than does the Brunt-Vaisala frequency at a given depth. In addition, the calculation includes a measure of the depth of the water and hence the proximity of tailings turbidity layers to the surface waters.

The STD data were used to estimate the amount of energy necessary to raise bottom water (and its associated particulates) under pre-discharge conditions and from the new bottom (after 55 years of discharge) to the 50 m isobath. A critical, untestable assumption is that the density structure of the water column by season remains unchanged from pre- to post-discharge conditions. Although this assumption cannot be verified, it is believed that a comparison of the relative merits (and risks) of the two fjord systems can be made by comparing the amount of energy necessary to elevate particulates from deep water to the 50 m isobath.

The initial run of the energy calculations used the density at the deepest point at which density was recorded on the cast. The calculations were made for each cast at each station. Since the difference in density between the deepest density measurement and 50 m varies by cast, the amount of energy necessary to raise the particle to the reference depth of 50 m will also vary. In a few cases, density data were not collected below 50 m. These casts were deleted from the analysis since no energy would be needed.

The output of the sediment deposition model developed for U.S. Borax was used to estimate the new depth of the bottom at each of the stations at which density data were collected by the University of Alaska. Diagrams prepared by Ryan (1985a) for Boca de Quadra and Smeaton Bay (Ryan 1985b) show approximate bottom topography after 55 years of discharge.

For the post-discharge energy calculations, it was assumed that the density structure of the water column above the new bottom would be identical to pre-discharge conditions. There is no way to test this assumption as there is no known physical

oceanography study of a basin-and-sill fjord that has been turned into a basinless fjord. It is probably reasonable to assume, however, that at least for the middle basin of Boca de Quadra the assumption is valid since the total below-sill volume of the basin is much greater than the total volume of the discharge.

Comparison of pre-discharge and post-discharge energy calculations is shown on a seasonal basis in Table 3-7. The table reports mean values (and standard deviation) of the energy calculations (in joules) for January, April, July, and October STD data (Jones & Stokes Associates 1988) for all years. For the middle basin of Boca de Quadra, comparison is made between the means of the calculations for station BQ5 only, reflecting conditions in the upper reach of the middle basin where sediment deposition is expected to measurably alter bottom depth. For the purpose of this comparison, Station BQ4, located on the inner sill, is assumed to reflect nearby conditions in the inner basin and is combined with Station BQ3 to form the basis for inner basin calculations. Observations at Stations SB0 and SB1 are combined for Smeaton Bay, as are Stations WA1 and WA2 for Wilson Arm. The number of observations at the combined stations in each basin for each month is recorded as "N".

Table 3-7 shows a decrease in the amount of energy necessary to raise a neutrally buoyant particle from near bottom to a reference depth of 50 m from pre- to post-discharge conditions. This decrease in the amount of energy is an indicator of the decline in the basin's ability to keep suspended solids from entering the upper 50 m of the water column. As would be expected, conditions change the least in the middle basin of Boca de Quadra and most in the inner basin. Changes in winter conditions in Smeaton Bay and Wilson Arm are also large, but intermediate in magnitude and absolute value between the inner and middle basins of Boca de Quadra.

Suspended Solids Advection

Boca de Quadra

The discharge of mill tailings into either the middle or inner basin would result in increased concentrations of suspended particulates up-fjord of the Kite Island sill. In later years of the project, however, a discharge to the middle basin will result in the transport of some suspended tailings into the outer basin of Boca de Quadra. Vigorous upper level circulation of the outer basin would dilute the suspended tailings before they reach Revillagigedo Channel. Except for trace amounts of mill tailings, materials discharged into Boca de Quadra would remain within the fjord.

Table 3-7. Comparison of mean energy calculations for pre- and post-discharge[a].

Boca de Quadra Middle Basin (upper reach)

	Jan	Apr	Jul	Oct
N	3	4	3	7
pre-discharge	870 (80)	610 (120)	340 (210)	490 (80)
post-discharge	760 (90)	540 (110)	280 (160)	420 (80)

Boca de Quadra Inner Basin

	Jan	Apr	Jul	Oct
N	2	7	7	7
pre-discharge	170 (170)	120 (100)	100 (40)	230 (120)
post-discharge	50 (30)	20 (20)	50 (20)	110 (70)

Smeaton Bay

	Jan	Apr	Jul	Oct
N	4	5	4	15
pre-discharge	1,100 (40)	470 (70)	300 (60)	860 (110)
post-discharge	330 (40)	240 (40)	220 (40)	590 (120)

Wilson Arm

	Jan	Apr	Jul	Oct
N	5	5	4	32
pre-discharge	330 (200)	240 (40)	230 (40)	620 (160)
post-discharge	80 (40)	120 (50)	170 (30)	180 (100)

[a] All values in joules. Values in parentheses are standard deviation; sample size (STD casts) is "N".

Inner Basin Discharge. The numerical model results suggest that, during the first years of mine operations when tailings are filling the inner basin, the suspended sediments initially would be confined to the vicinity of the inner basin. The details of the numerical calculations may not be exact; however, the trends indicated by the calculations are likely to be correct. After the inner basin has filled with the tailings, an inner basin discharge would behave similar to a middle basin discharge, i.e., suspended materials would be found in both basins. The numerical model suggests that higher concentrations of suspended materials would be found at shallower depths in the inner basin from an inner basin discharge than from a middle basin discharge. Filling the inner basin to a depth of 80 m (260 ft), which is above the depth of the Kite Island sill, would place the more dense turbidity zones within the seasonal range of the pycnocline. A protective, dense layer of water cannot be maintained at this shallow depth when the coastal pycnocline falls below sill depth during the winter.

Middle Basin Discharge. The inner sill has a maximum depth of 110 m (360 ft) and the fjord rapidly deepens seaward of this sill. Once a channeled flow has been established, there is little likelihood that large quantities of tailings will be transported from a middle basin discharge into the inner basin.

Certainly the bulk of the discharge will flow to depths in the middle basin far below that of the inner sill depth and therefore can never be brought to the inner basin. The only tailings that could affect the inner basin are tailings put into suspension. Tailings discharge to the middle basin would result in a wider dispersal of suspended materials than the first few years of inner basin discharge. The great depth of sediment deposition and mass movement relative to sill depth will probably result in confinement of suspended particulates to the middle basin, with the possible exception of deepwater renewal. Thus, levels of suspended particulates could be high in deeper waters of the middle basin because of poor or infrequent flushing. Concentrations of suspended sediments in the inner basin and the inshore part of the outer basin also would be elevated above current background. But since most slumping of tailings would occur at depths in the middle basin, the readjustment processes in the deposited tailings does not represent a major source of sediments at the depth of the inner sill.

Suspended tailings at the depth of the inner basin sill as a result of discharge to the middle basin could be as high as 50 percent of the concentration near the bottom (Kowalik 1984). If this concentration persisted throughout the year, fine tailings settling within the inner basin could produce a

significant deposition rate. Assuming a steady-state suspended tailings concentration of 100 mg/l, Ryan (pers. comm.) estimated a deposition rate of 30 cm/yr. The fjord circulation model was run only for summer conditions, and winter flow into the inner basin is less than summer inflow. If Ryan's calculation is taken for half a year, then the sedimentation rate would be 15 cm/yr. The estimate was based on the fjord circulation model for 10 um particles and assumed a dry density of settled tailings of 613 kg/m^3 (50 lb/ft^3), which may be low by a factor of two. To further complicate the estimate, bottom concentrations could range from 200-2,000 mg/l (Figure 3-7).

The estimated lower bound assumes the inner basin receives one annual replacement of water containing sediments at 100 mg/l. If all of this sediment settled out, the sedimentation rate would be 4 cm/yr. The best estimate is probably 4-15 cm/yr of deposition in the inner basin. A study based on core samples obtained in Boca de Quadra established sedimentation rates for various locations in the fjord (Burrell 1983). Upfjord of the Kite Island sill, deposition rates are 1 cm/yr. This rate appears to have been relatively uniform for the past 30-40 years. Sedimentation rates in the inner basin have been estimated as an average of 0.9 cm/yr. Thus, discharge into the middle basin could result in a 4- to 16-fold increase in the rate of sedimentation in the inner basin.

Thus, in summary, a discharge into the middle basin would result in increased sedimentation rates in the inner basin and part of the outer basin, but would not appreciably affect their depth. A discharge into the inner basin would initially confine suspended sediments to the vicinity of the inner basin. A discharge into the inner basin would also elevate sediment concentrations near the pycnocline in the inner basin more than a middle basin discharge. After the inner basin has been filled, the suspended sediment patterns would not differ from either a middle or inner basin discharge.

Smeaton Bay

Transport of fines out of Smeaton Bay into Behm Canal is projected to occur at concentrations of 32-54 mg/l (EPA 1988). As no information is available on the hydrography/circulation of Behm Canal, it is not possible to determine the ultimate fate of the exiting fines. During the fjord study program, an attempt was made to place a STD station in Behm Canal. Wind and current conditions made it difficult to continue with this array. This suggests that sediments may be rapidly dispersed in the waters of Behm Canal.

At the end of the project Smeaton Bay would have only a small, shallow (45 m [150 ft]) basin below sill depth to retain dense water during the summer. This will have consequences on

the circulation. Without retention of upwelled summer waters, there will be no winter outflow of water over the outer sill. Without mean flows near sill depth (inward in summer, outward in winter), the fjord circulation will be driven by runoff and winds. Because runoff is weak, winds will increase dramatically in importance in determining Smeaton Bay circulation. East Sound in the San Juan Islands of Washington State (maximum depth 30 m [100 ft]) is a smaller scale example of such an estuary (Rattray 1967). Such estuaries are more responsive to changing conditions at their mouths than estuaries with a net outflow at depth.

It does not appear that suspended sediments will reach as high in the water column in Smeaton Bay as they might in Boca de Quadra because Smeaton Bay is smaller, communicates more freely with outside waters, and has only one deep outer sill. However, where suspended tailings are present at comparable water depths in both fjords, the concentration of suspended tailings in the water column is generally higher in Smeaton Bay (EPA 1988). The flushing of suspended tailings into Behm Canal should be greatest in fall and late in the project. The fall seasonal peak in flushing occurs as the coastal pycnocline falls to and below the depth of the outer Smeaton Bay sill and denser water in Smeaton Bay above sill level flows down-gradient.

Section 4

COMPOSITION OF BIOLOGICAL COMMUNITIES

Summary

Boca de Quadra is approximately 57 km (35.5 mi) long and is subdivided by sills into three basins. Smeaton Bay is approximately 20 km (12 mi) long and is a single, undivided basin separated from Behm Canal by a sill. The biological communities of both fjords are influenced by several important abiotic factors, including the development of a pycnocline during spring and summer, ice along the periphery of the fjord in winter, and potential declines in oxygen levels in deep habitats in winter.

The spring phytoplankton bloom occurs between March and early May and is closely followed by increased zooplankton production. Although primary production is limited to depths above 8-25 m (26-82 ft), several herbivorous zooplankton species (e.g., euphausiids and copepods) important to higher trophic levels are likely to undergo diurnal vertical migrations between shallow and mesopelagic waters. Copepods are the dominant zooplankton group. There are few systematic differences in the spatial distribution of zooplankton within each fjord. Copepods are more abundant in the middle basin of Boca de Quadra than in the inner basin; within Smeaton Bay, copepods are least abundant at the shallow heads of Wilson and Bakewell Arms. There appear to be no significant differences in total primary phytoplankton productivity or zooplankton abundance between the fjords. Spatial variations in primary production of phytoplankton are slight within both fjords and are generally insignificant relative to temporal variations. Boca de Quadra appears to be generally more variable in plankton productivity and abundance due to its greater size and environmental heterogeneity.

Rocky intertidal, rocky subtidal, soft-bottom intertidal, and soft-bottom subtidal benthic habitats occur in both Boca de Quadra and Smeaton Bay. The dominant benthic habitat in terms of area is the subtidal soft-bottom habitat, which is characterized by distinct shallow, mid-depth, and deep benthic assemblages. In general, abundance of infauna (number of individuals) is greatest in shallow and mid-depth assemblages of both fjords. The economically important epifauna (e.g., Dungeness crab and shrimp) are most abundant at the shallow depths and mid-depths of both fjords.

One of the largest herring spawning grounds in southeast Alaska (approximately 10-15 percent of the herring in southeast Alaska) occurs at the mouth of Boca de Quadra. Both Boca de

Quadra and Smeaton Bay are important rearing habitats for young-of-the-year and age-1 herring. Boca de Quadra probably has relatively greater density and abundance of juvenile herring because of its proximity to the major spawning ground and its larger size. Overwintering herring in Boca de Quadra are known to migrate vertically from 125-150 m to the surface on a diel basis. Adult salmon are abundant in both fjords. The tributaries entering Wilson Arm support a much larger salmon run (1.4 million) than tributaries to Boca de Quadra (0.4 million). The estuaries and nearshore areas of both fjords are also important rearing habitats for juvenile salmon, which occupy the upper 20 m of the water column. Certain demersal fish species (e.g., walleye pollock and slender sole) are substantially more abundant in shallow areas of Wilson Arm and Boca de Quadra inner basins than in deeper areas of Smeaton Bay and Boca de Quadra middle basin.

Harbor seals are the dominant marine mammal in the two fjords. Groups of 20 and 30 seals have been observed in haulout areas in Boca de Quadra. Other seals, sea lions, porpoises, and whales are transient visitors. An unconfirmed sighting of a humpback whale in Boca de Quadra is the only endangered marine mammal sighting.

Little is known about birds in open water environments of Boca de Quadra or Smeaton Bay, although the Keta River and Wilson River estuaries appear to be important habitats. Overwintering could be an important avian use of the fjords; but studies have not been conducted in the fjords during the winter.

In general, the Wilson Arm estuary, the Keta River estuary, herring spawning grounds at the mouth of Boca de Quadra, and all habitats less than 100 m (330 ft) deep are important areas for marine organisms.

Introduction

This section provides an overview of the biological communities, ecosystem processes, and important habitats of Boca de Quadra and Smeaton Bay. Potential physical and chemical impacts to the biota are summarized in Section 5. More detailed descriptions of plankton, benthos, fish, mammal, and bird resources are found in Appendices A-E, respectively.

Overview of Biological Communities and Ecosystems

Boca de Quadra and Smeaton Bay are fjords in southeastern Alaska. Boca de Quadra is approximately 57 km (35.5 mi) long and is separated into three basins by sills. The inner basin sill rises to 110 m (360 ft) from depths of 170 m (560 ft), whereas

the Kite Island sill rises to 95 m (310 ft) from 400 m (1,320 ft). The outer sill rises to 85 m (280 ft) from 375 m (1,230 ft). The Smeaton Bay fjord consists of one main basin that is 20 km (12 mi) long, reaching a maximum depth of 285 m (940 ft). A sill rising to a depth of 130 m (430 ft) isolates the fjord basin from Behm Canal.

Numerous abiotic factors often act synergistically and affect the biological communities of these two fjords. Important abiotic factors include: a variety of substrate types and depths; sedimentation and organic input from rivers; wind-driven surface currents; moderate tidal fluctuations; increasing light levels, temperature, and water runoff during spring; development of a pycnocline during spring and summer; and ice along the shoreline and potentially low oxygen levels in deep habitats during winter.

In both fjords the spring phytoplankton blooms occur between late March and early May (Appendix A). The primary factors controlling phytoplankton production and species composition are nutrient concentrations, light intensity, degree of water stratification, grazing, and advection. The spring bloom is probably triggered by increasing solar radiation and is enhanced by the formation of a pycnocline which increases residence times of phytoplankton in well-lit surface waters. The depths of the blooms vary; the epicenters are generally located between 2-10 m (7-33 ft). Nutrient limitation (primarily nitrogen, phosphorus, and silicon) and grazing are important factors that end the spring bloom. A secondary, summer bloom may occur as a result of nutrient re-cycling by zooplankton. Diatoms are the principal agents of spring blooms; microflagellates are primary contributors to summer blooms and provide a substantial background of standing stock and primary production during other times as well. Low light intensities generally limit phytoplankton growth during autumn, winter, and spring.

Differences in primary production between the two fjords (VTN 1983b, p. 36) appear to be insignificant relative to interannual variations within each fjord. Also, despite the influence of hydrography on horizontal distribution of phytoplankton species within the fjords, the differences in total primary productivity between the inner and middle basins of Boca de Quadra are insignificant when compared with inter-annual variations within each basin (Appendix A). A long time series of data on the order of years would be necessary to determine whether there is a significant difference between primary productivity of the inner and middle basins. Based on general knowledge of fjord ecosystems, it is reasonable to expect the inner basin to be less productive than the middle basin with respect to primary productivity of phytoplankton because it is further from the source of oceanic plankton. However, it is also expected that

primary productivity of macroalgae in shallow areas near the head of the inner basin would contribute significantly to the overall primary and secondary productivity of the inner basin.

The cycle of zooplankton abundance in these two fjords is linked to phytoplankton dynamics. Major peaks in total zooplankton biomass occur between late May and mid-June just after the spring phytoplankton bloom (VTN 1983b, p. 48). Copepods are the dominant zooplankton group; fluctuations in total zooplankton biomass are closely correlated with changes in copepod abundance. Larval euphausiids generally peak in March, April, and June. Populations of predatory zooplankton species (e.g., chaetognaths, medusae, and the amphipod Parathemisto pacifica) increase just after the major spring increase in grazer populations (VTN 1983b, p. 47).

Zooplankton abundance and species composition vary with depth in both fjords. Total zooplankton abundance is greatest near the surface (0-25 m) compared to the 25-100 m sampling strata, particularly during spring and summer phytoplankton blooms (VTN 1980, p. 68; VTN 1981b, p. 57). Herbivorous copepods and predatory medusae, ctenophores, and chaetognaths dominate the epipelagic zone. Mesopelagic zooplankton groups include herbivorous copepods, predatory amphipods, and omnivorous euphausiids. Five of the six major mesopelagic species were observed to vertically migrate in the fjords (VTN 1983b, p. 47) Of these, the omnivorous euphausiids are particularly important as prey of fishes, birds, and mammals.

Within both fjords, hydrography appeared to influence the horizontal distribution of some zooplankton species. For example, the average copepod density in the middle basin of Boca de Quadra (19,000 individuals/m^3) was substantially greater than in the inner basin (10,000-12,000 individuals/m^3). Little or no differences between inner and middle basins were found for tintinnids, hydromedusae, chaetognaths, or the amphipod Parathemisto pacifica (VTN 1980, Fig. 3.3-14). In Smeaton Bay, copepods were least dense at stations near the shallow heads of the fjords.

Four types of benthic habitat are present within Boca de Quadra: 1) rocky intertidal, 2) rocky subtidal (mostly 0-10 m [0-33 ft] depth), 3) soft bottom intertidal, and 4) soft bottom subtidal (mostly >10 m depth). Each habitat supports characteristic invertebrate assemblages. Within-habitat zonation occurs and is largely related to substrate character and depth.

General characteristics and locations of the four benthic habitats are summarized in Table 4-1. Rocky intertidal areas occur along most of the perimeter of Boca de Quadra and Smeaton Bay. Dominant species include rockweed (Fucus distichus), barnacles (Balanus glandula), mussels (Mytilus edulis), and

Table 4-1. General Characteristics of Benthic Habitats in Boca de Quadra and Smeaton Bay

HABITAT	ZONE	LOCATION	CHARACTERISTIC ORGANISMS[a]
Rocky intertidal	High intertidal and gradual slopes	Throughout fjords	Rockweed
	Low intertidal and all slopes	Throughout fjords	Barnacles, mussels
Soft-bottom intertidal	High intertidal	Keta and Wilson River mud flats	Sedge, insects
	Middle intertidal	Keta and Wilson River mud flats	Rockweed, amphipods
	Low intertidal	Keta and Wilson River mud flats	Polychaetes, bivalves, harpacticoids, eelgrass (Wilson mud flats only)
Rocky subtidal	Vertical walls	Throughout fjords	
	0-3 m		Red algae, barnacles, sea urchins, sea stars
	3-7 m		Kelps, red and brown crustose algae, gastropods
	7-10 m		Brachiopods, tunicates
	Gradual slopes	Throughout fjords	
	0-2 m		Eelgrass
	2-10 m		Sea stars, bivalves
Soft-bottom subtidal	20-100 m	BQ inner basin and Smeaton Bay	Polychaetes, bivalves, Dungeness crabs, Tanner crabs, pandalid shrimps, pinch bug crabs
	100-200 m	BQ inner basin and Smeaton Bay	Polychaetes, bivalves, Tanner crabs, pandalid shrimps
	200-330 m	BQ middle and outer basins	Polychaetes, bivalves, sidestripe shrimp, Tanner crabs, heart urchins, mud stars

[a] Larger organisms are listed here.

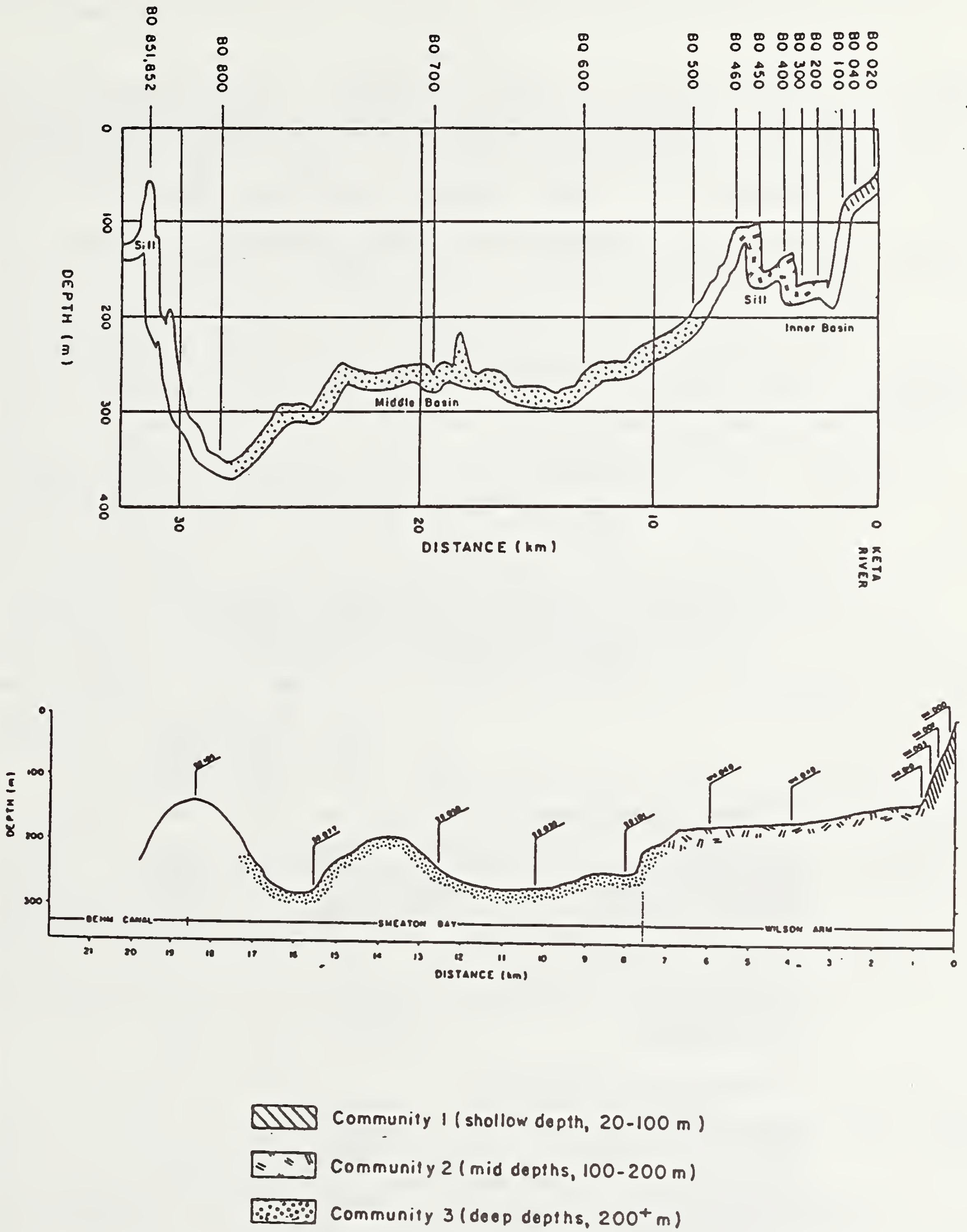
SOURCE: VTN 1983b, Table 4.2.1.

understory invertebrates such as small arthropods and molluscs. Soft-bottom intertidal areas occur primarily at the head of the two fjords and the head of all side arms. Dominant species include sedge (Carex sp.), rockweed, and a variety of polychaetes, molluscs, amphipods, harpacticoid copepods, and chironomids. Rocky subtidal habitats occur along the perimeters of the fjords. Major species include red algae (Ahnfeltia plicata and Constantinea subulifera), kelps (Laminaria spp. and Agarum fimbriatum), sea urchins (Strongylocentrotus spp.), sea stars (Evasterias troschellii and Pycnopodia helianthoides), limpets (Acmaeidae), tunicates (Ascidiacea), chitons (Ishnochitonida and Mopaliidae), and sea pens (Pennatulacea).

The dominant benthic habitat in terms of area is the subtidal soft-bottom habitat. Nearly the entire bottom below 35 m (110 ft) is soft-bottom. Three types of infaunal communities associated with specific depths are present in both fjords: shallow (20-100 m), mid-depth (100-200 m), and deep (>200 m). The shallow and mid-depth communities of Boca de Quadra are found within the inner basin and side arms and are physically separated from the deep community of the middle basin. The three community types grade into one another in Smeaton Bay with no distinct physical barriers (Figure 4-1).

The communities are associated with particular sediment characteristics and community parameters (Appendix B). In general, the shallow and mid-depth infaunal communities of Smeaton Bay and Boca de Quadra inner basin are more productive (number of individuals) than deep communities (Table 4-2). Shallow communities are often dominated by a few taxa that are very abundant (especially polychaetes). Mid-depth and deep communities can be more diverse (Shannon-Wiener species diversity index) than shallow communities because of a more even distribution of abundance among species. Total infaunal biomass is greatest in deep communities because of the presence of large deposit-feeding heart urchins. Shallow and mid-depth communities are associated with slightly coarser sediments containing a higher volume of organics but lower combustible organic content. Deep communities are associated with relatively fine sediments that are organically rich (combustible organics) but low in volume of organic material.

Subtidal, epifaunal assemblages were also of three types, depending on depth (Appendix B). In general, shallow and mid-depth epifaunal assemblages were richer in number of taxa than deep assemblages. Economically important epifauna such as Dungeness crab and pandalid shrimp were most abundant in trawl catches taken from Boca de Quadra inner basin and the shallower portions of Smeaton Bay (Table 4-3). Shrimp caught in pots were most abundant along the sides of fjord basins at shallow and mid-depths (0-150 m [0-490 ft]). Although total epifaunal biomass was greatest in the middle basin of Boca de Quadra and the deep



DISTRIBUTION OF SOFT-BOTTOM, SUBTIDAL COMMUNITIES IN BOCA DE QUADRA AND SMEATON BAY

FIGURE 4-1

SOURCE: VTN 1983b, Figures 4.2-6 and 4.2-7

Table 4-2. Major Characteristics of Infaunal Assemblages of Boca de Quadra and Smeaton Bay[a].

DEPTH OF ASSEMBLAGE	SPECIES RICHNESS		SPECIES DIVERSITY[c]		NUMBER OF INDIVIDUALS		ABUNDANCE OF POLYCHAETES		ABUNDANCE OF MOLLUSCS		ABUNDANCE OF CRUSTACEANS		ABUNDANCE OF ECHINODERMS	
	PARAMETER[b]													
	BQ	SB	BQ	SB	BQ	SB	BQ	SB	BQ	SB	BQ	SB	BQ	SB
Shallow (20-100m)	35.75	22.50	2.98	1.95	242.5	405.75	172.0	381.2	46.5	66.75	7.0	2.25	3.65	2.2
Mid-depth (100-200m)	24.50	27.75	2.54	2.43	144.75	423.25	57.7	113.3	30.5	48	7.5	8.5	1.95	0.45
Deep (200+m)	19.50	24.50	2.45	2.17	45.25	79.75	22.7	22.2	11.5	6.5	1.5	4.0	2.0	16.8

a Numbers are mean values for data collected simultaneously from both fjords (March & September of 1981 and 1982)
b Abundance per 0.1 m^2 (1.0 mm sieve)
c Shannon-Wiener

SOURCE: Modified from VTN 1983b, Table 4.2-5

Table 4-3. Comparison of Catches (CPUE) of Dominant Large, Epifaunal Invertebrates in Boca de Quadra and Smeaton Bay during 1981

	WA	SB	BQ INNER BASIN	BQ MIDDLE BASIN
A. TRAWL CATCHES (kg/km)				
Cancer magister	1.2246	0	0.098	0
Chionoecetes bairdi	2.1470	0.0857	0.858	0.312
Pandalid shrimps	5.3918	1.0572	5.551	0.947
Brisaster latifrons	0	18.9200	0	0.079
Ctenodiscus crispatus	0	8.6614	0	5.694
B. SHRIMP POT CATCHES (kg/day)				
Cancer magister	<0.01[a]		0	0
Pandalid shrimps	0.251[a]		0.51	0.60
Chionoecetes bairdi	0.03[a]		0.02	0.02
C. TANNER POT CATCHES (kg/day)				
Cancer magister	4.7943[a]		-	-
Chionoecetes bairdi	2.1560[a]		-	-

WA Wilson Arm
SB Smeaton Bay
BQ Boca de Quadra
a Data available only for Wilson Arm and Smeaton Bay combined.

SOURCE: VTN 1981b, Tables 4.3-4, 4.3-14, VTN 1982a, d.

areas of Smeaton Bay, this was primarily because heart urchins (Brisaster latifrons) and mud stars (Ctenodiscus crispatus) comprised the majority of the epifaunal biomass in trawl catches from these areas. Heart urchins and mud stars are not expected to be key links to higher trophic levels in community food webs.

Boca de Quadra and Smeaton Bay fjords are similar with respect to species composition of infaunal and epifaunal benthic assemblages and environmental factors that influence them. Presently it is not possible to draw statistically significant conclusions regarding the relative richness and benthic productivity of the soft-bottom communities of the two fjords, due to insufficient sampling. However, limited sampling (two sampling periods/yr) of the two fjords during two consecutive years (1981-82) suggests that shallow and mid-depth infaunal communities in Smeaton Bay may be more productive (number of individuals) than comparable communities in Boca de Quadra inner basin (Table 4-2). This seems reasonable from general considerations of fjord ecosystems. Smeaton Bay is shorter than Boca de Quadra and not separated into distinct basins. Therefore, two major inputs of carbon, oceanic plankton and autochthonous and allochthonous organic materials at the heads of the fjord, are more likely to mix in Smeaton Bay and provide a more diverse food source. In Boca de Quadra, on the other hand, carbon inputs at either end of the fjord are more likely to be isolated from one another.

Seventy-five species of fish have been identified from nearshore, pelagic, and benthic habitats of both fjords (Appendix C, Table C-2). Dominant species of the nearshore are juvenile salmon (Oncorhynchus spp.), juvenile herring (Clupea harengus pallasi), sand lance (Ammodytes hexapterus), and starry flounder (Platichthys stellatus) (VTN 1983b, Table 4.3-1). Pelagic habitats are utilized by herring, salmon, and an abundance of larval fishes. The number of larval fishes suggests that many fish spawn in the two fjords, although some fishes such as herring and pollock spawn primarily outside the fjords.

The major fish habitat in terms of species number is the benthic habitat, especially areas less than 150 m (490 ft) deep. Over 40 species of demersal fish have been identified from this habitat. Dominant fishes include eelpouts (Zoarcidae), English sole (Parophrys vetulus), walleye pollock (Theragra chalcogramma), flathead sole (Hippoglossoides elassodon), pricklebacks (Stichaeidae), and sculpins (Cottidae) (VTN 1980, pp. 100, 103; Envirosphere 1984, p. 3-73).

Both fjords support sizeable populations of adult salmon, but the Smeaton Bay run is clearly larger. Tributaries of Wilson Arm support the largest number of salmon entering the two fjords, with an average run of 1.4 million salmon (catch + escapement). The average salmon run to Boca de Quadra inner basin is

approximately 0.4 million. Pink salmon are by far the most abundant species. Juvenile salmonids which migrate primarily during March-August are likely distributed in the upper 20 m (66 ft) of the water column (Straty 1974; VTN 1982b; Rogers pers. comm.).

One of the largest populations of herring in Southeast Alaska (approximately 10-15 percent of all herring in southeast Alaska) spawns near the mouth of Boca de Quadra at Kah Shakes Cove (Blankenbeckler pers. comm.). Juvenile herring were the most abundant fish captured in nearshore habitats of both fjords, and data on the distribution of age-1 herring in Boca de Quadra suggest that the fjord functions as a year-round rearing habitat. During winter, herring in Boca de Quadra are found along the slope near 125-150 m (410-490 ft) during the day and dispersed near the surface during the night. Herring also overwinter in Smeaton Bay. A greater abundance of juvenile herring are expected to occur in Boca de Quadra than in Smeaton Bay because Smeaton Bay is farther from the Kah Shakes Cove spawning grounds and is smaller (Blankenbeckler pers. comm.; Hay pers. comm.).

In comparing the two fjords, demersal fish species composition tends to be similar within the same habitat types. Wilson Arm is comparable to Boca de Quadra inner basin, and Smeaton Bay downfjord of Wilson Arm is comparable to Boca de Quadra middle basin. In both fjords, the abundance of demersal fish is markedly lower in deeper areas (Boca de Quadra middle basin and western Smeaton Bay) relative to shallower areas (Boca de Quadra inner basin and Wilson Arm) (Tables 4-4 and 4-5). The data, however, should not be compared between fjords because the sampling year differs. Little is known about the adult fishes of epipelagic and mesopelagic zones in either fjords.

At least 12 species of marine mammals could occur as either seasonal migrants or residents in Boca de Quadra and Smeaton Bay. Although only a few species have actually been observed in the two fjords, observation periods to identify migratory and/or seasonally occurring mammals have been brief. Marine mammal species expected at least seasonally in the vicinity include five whale species, four porpoise and dolphin species, two seal species, and the sea lion. Species identified in Boca de Quadra and Smeaton Bay include the harbor seal (*Phoca vitulina richardii*), Dall porpoise (*Phocoenoides dalli*), and killer whale (*Orcinus orca*) (Wood pers. comm.; VTN 1982g, p. 1). Steller sea lions have been sighted near the mouth of Boca de Quadra. An unconfirmed sighting of the endangered humpback whale was made in Mink Bay; numerous sightings of the humpback whale have been made in the vicinity of the Quartz Hill project (VTN 1982g, pp. 14-15).

Table 4-4. Mean Catch Per Unit Effort (CPUE)[a] of Trawl Cruises by Major Taxonomic Group and Basin in Boca de Quadra During 1979-80

FISH FAMILIES	INNER BASIN MEAN CPUE	INNER BASIN PERCENT TOTAL[b]	INNER BASIN PERCENT FISH	MIDDLE BASIN MEAN CPUE	MIDDLE BASIN PERCENT TOTAL	MIDDLE BASIN PERCENT FISH
Rajidae	0.092	1.65	2.94	0.008	0.10	7.31
Pleuronectidae	0.900	16.18	28.83	0.041	0.56	39.22
Agonidae	0.037	0.67	1.20	0.004	0.05	3.42
Anoplopomatidae	-	-	-	-	-	-
Bathymasteridae	0.008	0.15	0.27	-	-	-
Clupeidae	0.008	0.14	0.26	0.001	0.02	1.23
Cottidae	0.553	9.95	17.73	0.024	0.32	22.32
Embiotocidae	0.017	0.31	0.55	-	-	-
Gadidae	0.387	6.96	12.40	0.013	0.18	12.44
Osmeridae	0.001	0.02	0.03	0.003	0.04	2.85
Cyclopteridae	-	-	-	0.004	0.05	3.51
Stichaeidae	0.228	4.10	7.30	0.006	0.08	5.41
Zoarcidae	0.889	15.99	28.49	0.002	0.03	2.28
Scorpaenidae	-	-	-	-	-	-
Total Fish	3.120	56.12	100.00	0.106	1.43	100.00

[a] CPUE in units of kg/km.
[b] Percent of fish and invertebrates in the catch.

SOURCE: VTN 1980, Table 4.3-6.

Table 4-5. Mean Catch Per Unit Effort (CPUE)[a] of Trawl Cruises by Major Taxonomic Group and Basin in the Smeaton Bay Fjord During 1981

FISH FAMILIES	WILSON ARM MEAN CPUE	WILSON ARM PERCENT TOTAL[b]	WILSON ARM PERCENT FISH	BAKEWELL ARM MEAN CPUE	BAKEWELL ARM PERCENT TOTAL[b]	BAKEWELL ARM PERCENT FISH	SMEATON BAY MEAN CPUE	SMEATON BAY PERCENT TOTAL[b]	SMEATON BAY PERCENT FISH
Rajidae	0.648	2.99	5.60	0.448	2.99	15.86	--	--	--
Pleuronectidae	5.955	27.49	51.46	1.528	10.19	54.08	--	--	--
Agonidae	0.056	0.26	0.48	0.035	0.23	1.24	--	--	--
Anoplopomatidae	0.720	3.32	6.22	0.342	2.28	12.10	0.444	1.51	76.23
Clupeidae	0.008	0.04	0.07	--	--	--	0.015	0.05	2.50
Cottidae	0.860	3.97	7.43	0.041	0.28	1.46	--	--	--
Embiotocidae	0.008	0.04	0.07	--	--	--	--	--	--
Gadidae	0.304	1.40	2.63	0.358	2.39	12.67	--	--	--
Osmeridae	0.013	0.06	0.11	--	--	--	--	--	--
Stichaeidae	0.023	0.11	0.20	0.052	0.34	1.83	0.103	0.35	17.62
Zoarcidae	2.967	13.70	25.64	0.021	0.14	0.75	0.021	0.07	3.65
Scorpaenidae	0.009	0.04	0.08	--	--	--	--	--	--
Total Fish	11.572	53.42	100.00	2.825	18.84	100.00	0.583	1.98	100.00

[a] CPUE in units of kg/km.
[b] Percent of fish and invertebrates in the catch.

SOURCE: VTN 1981b, Table 4.3-4.

The most numerous marine mammal inhabitant of Boca de Quadra is the harbor seal. Up to 20 seals have been observed on rocks near the head of Boca de Quadra and another 30 seals have been observed on Kite Island (VTN 1982g, p. 6). Seal haulout areas occur in both the inner and middle basins of Boca de Quadra, near the head of Wilson Arm, and near the junction of Bakewell and Wilson Arms in Smeaton Bay, although use of these areas may vary from year to year (VTN 1981a, p. 49; Rescan Environmental Services 1984, Table 6). Seals are present year-round, but they may periodically leave the fjord as they are known to move great distances (Pitcher and McAllister 1981, p. 292). Pupping probably occurs along the shoreline of the fjord and at the head of the bays. Killer whales are the most frequently sighted whale species in Boca de Quadra and have been observed in both inner and middle basins during spring and summer. Adults and juveniles have also been observed in Smeaton Bay about 1 km (0.6 mi) from Behm Canal.

Over 200 species of birds are known to occur along the Gulf of Alaska coast (Gusey 1978, p. 26). Approximately 87 species use inshore waters (within 6 km [4 mi] of shore, including islands), and 177 species inhabit mudflats and rocky shores (Isleib and Kessel 1973) such as those located in Boca de Quadra and Smeaton Bay.

Although some birds migrating north along the Pacific Flyway during spring may stop over in southeast Alaska, the majority of the tremendous populations of seabirds, shorebirds, and waterfowl migrate past southeast Alaska for staging grounds further north (Bellrose 1976; Arneson 1980; DOI 1984). During the southward flight, many seabirds and waterfowl stop in southeast Alaska to overwinter.

Field studies of marine or coastal birds focused on estuaries of Wilson, Bakewell, and Keta Rivers, with less emphasis on open water or rocky shore habitats. Intensive surveys of bald eagle nestings were also conducted.

The primary use of these fjords appears to be overwintering, as the estuaries are located along a major waterfowl migration route and are very productive. Waterbirds using these estuaries include loons, grebes, ducks, geese, sandpipers, gulls, and pelagic birds. All waterfowl groups, with the exception of bay ducks, were most abundant in Wilson estuary. Gulls were also most common in the Wilson estuary, especially in March during smelt spawning runs in the Wilson and Blossom Rivers. High numbers of gulls were also seen in Boca de Quadra in August feeding on large herring schools.

Significant breeding populations of the bald eagle were present along both fjords. During 1982, 29 nest areas were spotted along Smeaton Bay and the Wilson estuary. Ten were

located along Boca de Quadra and the Keta estuary. Eagles showed large seasonal fluctuations, but were particularly abundant in August, in conjunction with salmon spawning, and in March during smelt runs in the Wilson and Blossom Rivers.

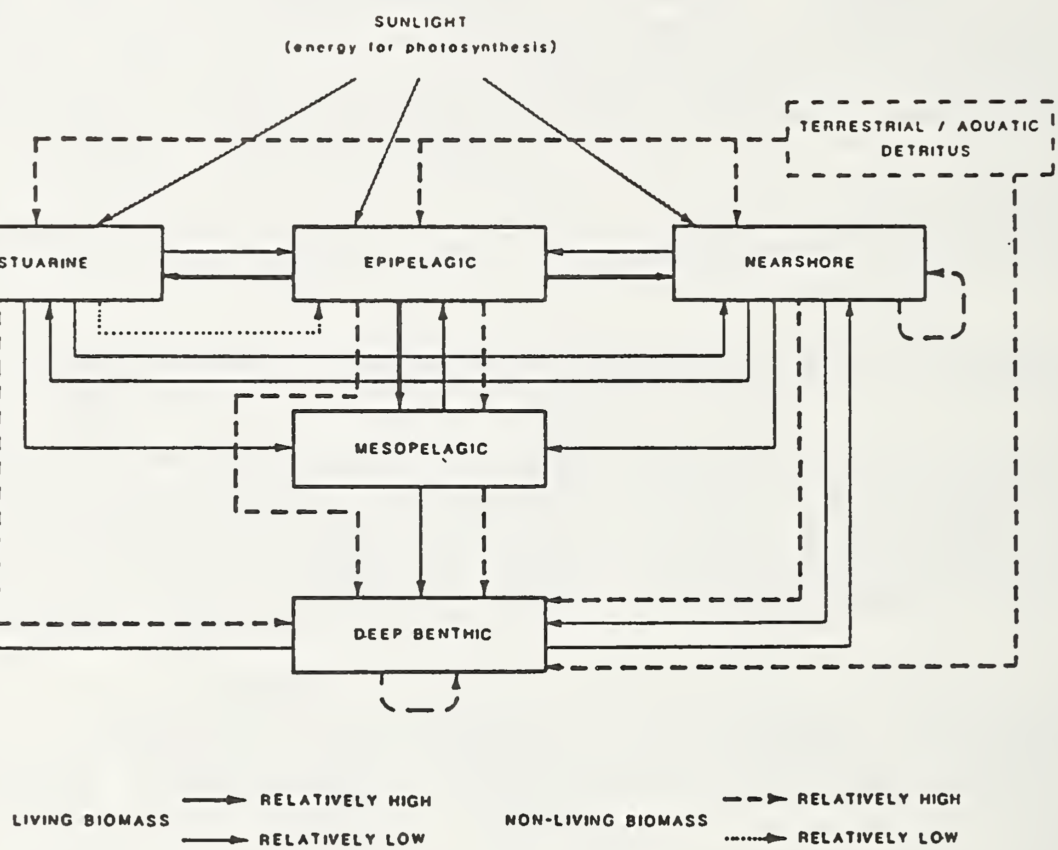
Food Webs of Boca de Quadra and Smeaton Bay

General food web relationships have been developed for epipelagic, nearshore, mesopelagic, deep benthic, and estuarine habitats in both fjords. The flow of energy through the five habitats follows a variety of pathways depending on the habitat. In general, major sources of energy to the epipelagic, nearshore, and estuarine habitats are sunlight (energy for photosynthesis) and detritus from terrestrial and aquatic sources (Figure 4-2). Predator-prey interaction within and between the habitats in the upper 10 m (330 ft) is also an important energy exchange mechanism. Most energy flow (detritus and prey organisms) is downward through the water column; it appears that deep benthic habitats contribute relatively little to habitats in the upper 100 m.

The epipelagic is the only habitat in which phytoplankton production is the major source of energy. The epipelagic food web is also quite simple relative to most other habitats (VTN 1983b, p. 149). The major energy pathways are from autotrophic diatoms and flagellates to herbivorous zooplankton to carnivorous fish, medusae, and several other major primary carnivores. These short food chains probably result in efficient energy transfer, thus supporting large populations of primary carnivores such as herring. Numerous birds and mammals rely on these fish for food.

The complex food web of the nearshore habitat (<10 m [33 ft] deep) is based on detritus and primary production from phytoplankton, macroalgae, and microalgae. Filter feeders such as barnacles, mussels, and sponges are abundant as a result of substantial phytoplankton production. These invertebrates, along with detritivores such as amphipods, isopods, and harpacticoid copepods, are major food items for fishes and other higher consumers.

The mesopelagic habitat supports the simplest food web of the five marine habitats (VTN 1983b, p. 151). Organic matter from the epipelagic zone in the form of zooplankton fecal pellets, carcasses, particulate debris, and phytoplankton cells is the basic source of energy. Euphausiids and copepods are the major primary consumers; they often migrate vertically into the epipelagic zone at night. The mesopelagic habitat supports very large populations of relatively few species. Little, however, is known about fish species in the mesopelagic zone.



FJORD ENERGY FLOW DIAGRAM

FIGURE 4-2

SOURCE: VTN 1983b, Figure 5.3-1

The deep benthic (>10 m) food web is supported primarily by detritus. Shallower areas of this habitat (10-100 m), such as the heads of the fjord and arms, have more species and more trophic linkages with other habitats. Mesopelagic euphausiids and copepods are important food items to several species in the shallower parts of the benthic community. Deep water clams and polychaetes consume organic matter from the water column; some polychaetes ingest sediments that contain organic matter. These organisms along with others provide food for the demersal fish community. Other food webs apparently derive relatively little energy from the deep benthic habitat, although pelagic eggs from demersal fish are seasonally important food for herring in Boca de Quadra (VTN 1982c, pp. J-2 to J-18).

For the purpose of this report, estuarine habitat is defined to include the shallow water habitat shoreward of the toe of the alluvial deposit formed at the head of Boca de Quadra and Wilson Arm by the Keta and Wilson rivers, respectively. Thus, estuarine habitat includes shallow subtidal as well as intertidal habitats in these areas.

The estuarine food web includes marsh and mud flat communities. Detritus from marsh plants (e.g., sedges) is a major energy source (VTN 1983b, p. 154). Dominant invertebrates are detritovores and deposit feeders such as harpacticoid copepods, amphipods, isopods, and a clam (Macoma spp.). Also, insects are important marsh plant grazers. Outmigrating juvenile salmonids consume many of these invertebrates; returning adult salmonids attract large numbers of predatory mammals and birds.

Important Habitats of Boca de Quadra and Smeaton Bay

An important marine habitat is defined here as an area utilized by a disproportionate abundance of individuals and/or species or an area essential to the ecosystem. The Kah Shakes Cove area at the mouth of Boca de Quadra is a major herring spawning ground in southeast Alaska and is considered an important habitat. As an example of the large biomass of spawning herring, approximately 3,239 mt of herring were harvested in the 1983 commercial fishery at the mouth of Boca de Quadra (House pers. comm.). Herring are an important food item for other fishes, birds, and marine mammals in Boca de Quadra and adjacent areas.

Benthic infauna, epibenthic species of commercial value, and demersal fishes are significantly more abundant in shallow (20-100 m [66-330 ft]) and mid-depth (100-200 m [330-660 ft]) soft-bottom habitats of Boca de Quadra (i.e., the inner basin) and Smeaton Bay (Tables 4-2 through 4-5). Benthic infauna are important prey of demersal fishes and may contribute to the substantially greater abundance of demersal fishes in the Boca de

Quadra inner basin and shallow to mid-depth areas of Smeaton Bay. Although overall infaunal and epifaunal biomass is greatest within deep communities (>200 m), this is due to the abundance of the heart urchins and mud stars. Heart urchins and mud stars generally do not occur as prey of higher trophic level organisms.

In general, all pelagic and benthic habitats less than 100 m (330 ft) deep are important to the functioning of the marine community above this water depth. In studying Boca de Quadra and Smeaton Bay, VTN (1983b, pp.80-81) identified the shallow benthic community as that located above 100 m. Information supporting this community boundary can be found in VTN's (1983b) study of (1) benthic habitats (p.60), (2) soft-bottom subtidal organisms (pp.84-86), and (3) Dungeness and tanner crab distributions (pp.118-119). VTN (1983b, p.131) further found that the most densely populated part of the mesopelagic habitat is between the 50 and 150 m depths, and this habitat is the most stable of any habitat in the fjords.

Rocky intertidal and rocky subtidal areas down to 10 m (33 ft) are important sources of habitat and food for many benthic species, including importance as a source of detritus to those species at greater depth. Salmon occupy the upper 20 m (66 ft) of the water column, and herring penetrate down to 150 m (490 ft). The shallow (down to 100 m) subtidal soft-bottom benthic assemblage is the most productive of this habitat type and is used more by commercially valuable crabs than are deeper subtidal soft-bottom areas.

Both the Wilson and Keta estuaries are important habitats for adult and juvenile salmon and birds. The Wilson estuary is particularly important as it supports many more salmon (1.4 million) than the Keta estuary (0.4 million). This difference is reflected in the greater use of Wilson estuary by bald eagles, particularly during salmon runs. Wilson estuary also supports greater numbers of overwintering waterfowl (ducks and geese) than the Keta estuary.

Section 5

POTENTIAL IMPACTS OF DISCHARGED MILL TAILINGS

Summary

Acute toxicity of discharged tailings to marine organisms is expected to be low. Some acute toxicity may result from the presence of quaternary ammonium salts if significant dissociation occurs, but the significance of this potential toxicity cannot be presently assessed. The most likely effects are expected to be physical in nature. Studies with tailings from the nearby Kitsault molybdenum mine found that long term exposure to suspended solids concentrations of approximately 560 mg/l were necessary to induce significant mortalities on various zooplankton. Zooplankton may be used as indicators of toxicity, particularly if the toxicity includes physical effects of suspended solids. Since concentrations of 560 mg/l are not expected to occur above 20 m from the bottom of the fjord, significant acute toxic effects from exposure to the suspended particulate phase of the discharge are not anticipated above this level.

Testing performed with molybdenum tailings from the Kitsault Mine indicated increased trace metals leachability under slightly acidic conditions, as found in the digestive tracts of marine vertebrates. Ingestion of suspended tailings or of organisms on which tailings have accumulated (e.g., zooplankton) could result in uptake of trace metals. Tailings have been observed to accumulate on and in euphausiids and other zooplankton during bioassays. Zooplankton are important in the diets of fish, which in turn are consumed by other fish, birds, and mammals. Since many zooplanktonic organisms undergo diel vertical migrations, a major proportion of the food of higher trophic level organisms (that may otherwise not be in direct contact with tailings) could be contaminated. Because of the shallower water depths, this is more likely to occur in Smeaton Bay and the inner basin of Boca de Quadra than in the Boca de Quadra middle basin. The significance of shoaling of zones of active deposition and slumping for potential bioaccumulation and higher trophic level impacts cannot be determined at this time, but will be a function of the concentration and extent of suspended tailings fines in the upper mesopelagic (mid water column) zone.

High turbidity in the upper 20 m of the water column is not expected to occur. Increased turbidity is expected to occur below approximately 50 m, increasing with depth. This is within the depth range of juvenile herring overwintering in Boca de

Quadra as well as vertically migrating zooplankton. Zooplankton are not expected to be significantly affected by slightly increased turbidity; herring may behaviorally avoid suspended solids of >10 mg/l, based on laboratory studies. Increased turbidity in the upper mesopelagic zone could reduce the rearing area for juvenile herring in Boca de Quadra. The significance of this potential impact cannot be determined at this time. Juvenile salmon, which occupy the upper 20 m of the water column, should not be directly affected by suspended sediments.

Discharge to the inner basin will result in significant deposits over 450 hectares (1,100 ac) of the inner basin and 1,600 hectares (4,000 ac) of the middle basin. Colonization of deposited tailings by benthic organisms is expected to begin rapidly, primarily from larval settlement rather than immigration of adults from surrounding locations. Species colonizing new space, however, may not be the same species that occurred prior to discharge, particularly if there is a significant change in bottom depth. Bathymetry would be permanently altered in the inner basin, and the predischarge benthic community would be replaced by a shallow benthic assemblage. Discharge to the middle basin will result in disruption of benthic habitat over 1,600 hectares in the middle basin and probably minor changes in benthic community structure in the inner basin. Under either Boca de Quadra discharge alternative, permanent changes in bathymetry of the middle basin are not significant because the new depths remain within the domain of the existing assemblage of deep benthic organisms. Time necessary for complete recovery of benthic communities cannot be determined based on existing data. Species best adapted to colonizing new space will be present initially. Complete recovery in the middle basin will occur as natural sedimentation and biological reworking recreate the physical/chemical conditions of the predischarge bottom, but this process could take many years.

Discharge to the middle basin of Boca de Quadra is expected to result in increased sedimentation rates in the inner basin on the order of a few cm/yr. Most of this increase will occur during the summer (deepwater renewal period). Some alteration of the inner basin benthic community may occur, but not as rapidly or extensively as under the inner basin discharge option. This community alteration could include the loss of some suspension feeders and an increase in the importance of certain species able to rapidly colonize open spaces. Many of the larger benthic and demersal organisms (e.g., flatfish, crabs) will probably survive deposition rates predicted for the inner basin with middle basin discharge.

Discharge to Smeaton Bay is expected to result in disruption of benthic biota over 1,660 hectares (4,100 ac) in the bay and a change in the basin-and-sill nature of the system. Bathymetry and balance of forces driving circulation would be permanently

altered. Because the bay has less volume than the middle basin of Boca de Quadra, it would be filled to within 45 m (150 ft) of the sill by project completion. Benthic community composition will be substantially and permanently altered because the deepwater habitat (>200 m) will be replaced by mid-depth to shallow habitat.

Overall, the Boca de Quadra middle basin discharge option is expected to have less biological impact for several reasons:

- Fewer pelagic organisms would be exposed to the highest concentrations of suspended tailings because mass movement of solids (the predominant cause of elevated suspended solids) would be occurring in very deep water.

- Risk of biological effects in the upper water column (especially herring and their food sources) would be reduced since tailings would not be forced to spill over the dynamic area of the inner sill, nor would the areas of highest suspended sediment concentration ever overlap with the pycnocline.

- Direct smothering of the benthos would occur over a smaller total area relative to discharge to the inner basin of Boca de Quadra. Similar habitat area would be affected by discharge to Smeaton Bay.

- Colonization of the tailings deposits could be accelerated due to sources of larvae existing both downfjord and upfjord of the deposited solids.

- The risk of impacts to productive estuarine habitats would be least.

- Bathymetry would be least altered, making recovery of predischarge biological productivity possible. Discharge to Smeaton Bay or to the inner basin would substantially and permanently alter bathymetry, and post-project biota would reflect new depth conditions.

Introduction

Potential biological effects from the marine disposal of mill tailings include: 1) toxicity of solid or liquid phases of the discharges; 2) bioaccumulation of heavy metals or process reagents; 3) potential human health impacts; 4) effects associated with turbidity plumes or dissolved constituents in the upper water column; 5) direct burial/smothering of benthic organisms by tailing deposits; 6) alteration of physical and chemical characteristics of sediments; and 7) alteration of mechanisms of nutrient recycling and renewal resulting from

changes in bathymetry of the basins. Each of these is evaluated in relation to disposal of tailings from Quartz Hill for each marine disposal option.

Toxicity

Available information on the toxicity of organic milling reagents is insufficient for determining the hazard associated with their discharge. Of particular concern may be the reagents M-502 and SF330, which are quaternary ammonium salt polymers. Quaternary ammonium compounds are known to be toxic to a variety of marine species at the mg/l level (Boethling 1984, p. 1061), although other tests indicate toxicity is lower in natural waters than in clean laboratory water (Lewis and Wee 1983, p. 115). Decreased toxicity in natural waters might be caused by rapid adsorption to suspended solids. The salts are cationic in nature and may have a high affinity for negatively charged particles (e.g., suspended solids) or anionic tissues such as the gills of marine organisms. It is not known how adsorption to sediments, clays, and materials having negative surface charges affects biodegradation in the receiving water (Boethling 1984, p. 1074). Ionic bonding of these salts to gills could effectively reduce gas exchange (Kim pers. comm.). Thus, more information is needed on the fate and effects of the milling reagents (and their breakdown products) proposed for use at Quartz Hill.

Toxicity could also occur from exposure to constituents of diesel fuel, a major reagent in the milling process. It is expected, however, that the majority of diesel fuel will report to the molybdenum concentrate (Section 2, Tables 2-4 and 2-5), and the risk of toxicity is, therefore, likely to be low.

Copper, lead, nickel and mercury are metals in the tailings discharge that are of potential concern (Section 8). Water quality criteria for metals are based on the total recoverable metals methodology and are designed to protect a wide variety of marine species. Chronic criteria are probably most applicable to the nature of the proposed discharge. For copper, lead, nickel, and mercury, the chronic seawater criteria are 2.9 mg/l, 5.6 mg/l, 7.9 mg/l, and 0.025 mg/l respectively. Because total recoverable metals in the tailings effluent have not been measured, the toxicity of metal constituents to marine organisms cannot be accurately assessed.

E.V.S. Consultants (1984a; 1984b) performed short-term, acute lethality bioassays on Quartz Hill mill tailings produced by pilot plant operations. The two studies represent two different batches of pilot plant tailings obtained by modified mill processes and different milling reagents. The second batch is assumed to be more representative of the tailings discharge (E.V.S. Consultants 1984b, p. 3). It contained less total

organic carbon, but heavy metals concentrations were similar to that of the first batch (E.V.S. Consultants 1984b, pp. 19-20). The second batch of tailings was also used to examine chronic toxicity, bioaccumulation, and sublethal effects. A large dissolved organic reagent load was not evident in either batch of the tailings tested. Because these represent the only studies available on the toxicity of Quartz Hill mill tailings to marine organisms, they will be reviewed in some detail here.

Acute Toxicity

Initial tests with juvenile coho salmon (*Oncorhynchus kisutch*), mussel larvae (*Mytilus edulis*), amphipods (*Rhepoxynius abronius*), and euphausiids (*Euphausia pacifica*) apparently indicated that the acute toxicity of Quartz Hill tailings to these species was low. Reported LC50 or EC50 concentrations were as follows:

- coho salmon juveniles (96-hr LC50) : 208,000 mg/l
  (10-day LC50): 197,000 mg/l
- mussel larvae (48-hr EC50) : 145,000 mg/l
- amphipods (10-day LC50) : 150,000 mg/l
- euphausiids (96-hr LC50) : 109,000 mg/l

Subsequent tests with Dungeness crab zoea (*Cancer magister*), mussel larvae, and amphipods also indicated relatively low toxicity. Reported LC50 or EC50 concentrations were as follows:

- crab zoea (48-hr LC50) : 170,000 mg/l
- mussel larvae (48-hr EC50) : 142,500 mg/l
- amphipods (10-day LC50) : 86,000 mg/l

Certain factors, however, indicate that caution should be used in applying these concentrations at their stated (nominal) value.

In the initial coho, mussel, and possibly the euphausiid bioassays, tailings were placed in test containers at the equivalent of up to 240 g (240,000 mg) per liter of water. The tailings settled in the containers throughout the static test periods. The LC50 values for these species, therefore, are based on the initial concentration, but concentration of tailings in the water column decreased significantly over time and are not readily compared to the nominal concentration. For example, in the coho bioassay, mortality occurred only at the highest nominal concentration (240,000 mg/l). All 10 salmon died during the first day in this treatment; suspended solids on the first day were 2,543 mg/l. If toxicity resulted from particulates in

suspension, the 24-hr LC50 could be as low as 2,543 mg/l, i.e., two orders of magnitude less than the nominally-reported value. Several other studies exposing juvenile salmonids to fine particulates have reported 96-hr LC50s ranging from 1,500 to 54,000 mg/l (Noggle 1978; Smith 1978; Ross 1982). (Because suspended solids measurements were not reported for mussel larvae and euphausiid bioassays, similar comparison cannot be made for these species.) If the toxic effect was associated with dissolved constituents and not particulates, the nominal concentration may still be an inaccurate measure of toxicity because the adsorptive capacity of the solids may remove dissolved constituents. In the absence of the solids, higher levels of dissolved constituents could persist and effects (e.g., death) might occur at a higher rate. Results based on nominally reported concentrations, therefore, can significantly underestimate the inherent toxicity of the material, whether that toxicity is associated primarily with the suspended particulate or liquid phases.

In the initial amphipod bioassay, 240 g of sediment were used in each 1-liter test volume. Experimental treatments consisted of various dilutions of tailings solids with clean control sediment. A treatment having 50 percent tailings and 50 percent control sediment was defined as a 120,000 mg/l tailings treatment. Survival was 100 percent in unmodified control sediment and 0 percent in undiluted tailings. Unfortunately, the control sediment was 98.5 percent sand-sized particles while the tailings solids were 64.7 percent sand (E.V.S. Consultants 1984a, p. A-15). Rhepoxynius abronius, like many infaunal amphipods, exhibits pronounced sediment grain-size requirements (Oliver et al. 1982, pp. 179-184; Oakden 1981, pp. 1-62). The experimental treatments in which amphipods were exposed differed not only in amount of tailings but also in such parameters as grain size and organic content. The difference in particle size would affect particle settling rates, and organics may provide a food source for amphipods. An experiment in which organics were removed from the control sediment resulted in high control mortality of 17-70 percent; the cause could not be determined. The mortalities in the experimental treatments varied directly with decreases in these parameters as well as increasing tailings. Since the exact mode of effect is therefore not known, it is not clear whether the reported nominal LC50 value appropriately describes the toxicity of the tailings to this species.

In subsequent tests with the second batch of tailings, mussel larvae were tested in a similar fashion as before with up to 200,000 mg/l tailings. Although a similar EC50 value was found, the concentration of tailings in the water column over the 48-hr period was not the nominal concentration.

Static test conditions were also used on the Dungeness crab zoea, thus, nominal concentrations are not the exposure concentration. These experiments were also plagued by significant mortalities at high concentrations (56,000-250,000 mg/l) within 48 hrs and significant mortalities in controls and low concentrations by the end of the 96-hr test period. A 48-hr LC50 of 170,000 mg/l was interpolated using survival data from the three highest test concentrations (56,000-250,000 mg/l).

The amphipod bioassay tests on the second batch of tailings was conducted in a manner identical to that of the first batch. Two major differences are that the second batch of tailings had a higher percentage of fines (10.7 percent clay versus 2.4 percent) and a lower total organic carbon content (90 versus 400 ug/g) (E.V.S. Consultants 1984b, p. 20). The lower LC50 observed with the second batch may result from the effect of smaller grain size, or perhaps the lower organic content, or different milling reagents, or any combination of these factors.

The considerations described above suggest that the reported toxic concentrations for Quartz Hill mill tailings likely underestimate the actual concentrations at which acute effects may occur. Data from amphipod bioassays suggest that survival of this species is adversely affected with tailings composing 30-50 percent of the sediment. It is not known whether other burrowing species with sediment grain-size requirements would react similarly.

Acute toxicity studies also have been performed with tailings from the Kitsault Molybdenum Mine located on Alice Arm, 40 km to the east of Quartz Hill (Anderson and Mackas 1986). The milling process and reagents used at the Kitsault mine are similar to those proposed for use at Quartz Hill (Burling et al. 1981, pp. 11-12). Tailings were obtained from the discharge pipe and kept frozen until test solutions were prepared just prior to bioassays. Preparation consisted of combining 500 ml tailings slurry (>40 percent solids) with 2 liters of seawater, stirring vigorously, and allowing a 5-minute settling period before decanting. The test solutions were, therefore, a suspended particulate phase preparation (EPA/COE 1977) with a short settling period.

Tests with various zooplanktonic organisms (two copoped species and Euphausia pacifica) were conducted in triplicate in 1-liter containers in which particulates were kept in suspension by slow rotation of the containers. The nominal concentration should therefore be equal to the exposure concentration. Dilutions of the suspended particulate phase were used that resulted in solids concentrations from 0 to >1,100 mg/l; the lowest test concentration (non-control) was 22 mg/l. No mortality occurred after 96 hours. As a result, the tests were run to about 1,000 hr. Over this long period, a decrease in

median survival time was detected at a concentration of 560 mg/l. Enhancement of survival was suggested up to 40 mg/l. These data indicate that concentrations of suspended solids in all but the bottom layer of the fjord (Figure 3-7) are not expected to affect zooplankton.

Chronic and Sublethal Toxicity

E.V.S. Consultants (1984b) examined the effects of Quartz Hill pilot plant tailings on Dungeness crab zoea growth and development, clam (*Macoma balthica*) burrowing behavior, and phytoplankton (*Dunaliella tertiolecta*) growth. Problems with high mortality of crab zoea in all concentrations (including controls) in the first 7 days prevented valid results at the end of the 30 day test period.

Clams were maintained in control sediments or in containers with 4 cm of control sediment overlaid with 1 cm of tailings. After 1 month of testing, build-up of metabolic wastes required increasing the flow-through rate of water from 1 tank-volume to 1.5 tank-volume per day. Food sources were available to the clams. Median time to reburial (ET50) was noted at 0, 1, 2, 3, 4, 6, 12, and 16 weeks by sieving 40 clams from each of the control and test containers and placing 20 clams in clean sediments and 20 clams in tailings. Four experimental treatments were possible: control-reared clams reburying in clean sediments or tailings, and tailings-reared clams reburying in clean sediments or tailings.

Interpretation of the results is debatable. With the exception of weeks 2 and 12, clams that were maintained in tailings had generally a higher mean ET50, i.e., took longer to burrow into the sediments (E.V.S Consultants 1984b, p. 39). In this type of experiment, variability is typically high within each test. Although the report notes that analysis of variance showed no significant difference in ET50 between the four experimental groups (E.V.S Consultants 1984b, p. 38), this statistical test is based on the mean of the mean values noted for each treatment each time interval (Mitchell pers. comm.). Use of a nonparametric statistical test, for example, may lead to different conclusions. A major factor that would alter reburial time is the sediment grain size distribution of the control sediments and tailings. These data are not provided; therefore, it is not clear whether differences (or lack of differences) in reburial times are ecologically meaningful.

Tests on alga growth were conducted in triplicate. Control treatments and test concentrations of 1-10,000 mg/l tailings were shaken by hand once daily. Thus, the nominal concentration was equivalent to the exposure concentration for brief periods at regular (daily) intervals. Cell division initially was inhibited at the higher concentrations, but by the end of the 13-day

culture period the highest test concentration (10,000 mg/l) showed significantly greater cell density relative to the controls and other test dilutions. A corresponding high chlorophyll concentration in this test culture indicated the alga cells were healthy.

Respiration, feeding activity, and behavior of zooplankton were also monitored (0-1,100 mg/l tailings) as part of the Kitsault study (Anderson and Mackas 1986). Because no mortality was observed after 96 hr (see Acute Toxicity) the tests (using same individuals) were extended to about 1,100 hr (42 days). Respiration increased somewhat after 24 hrs at low levels (<40 mg/l) and decreased at higher concentrations (100 mg/l) in some tests. Feeding activity responded similarly. No significant effects on behavior were apparent. Zooplanktonic organisms were observed actively ingesting tailings solids, but external accumulations were not looked for.

Conclusions

Overall, the results of the bioassays suggest that tailings are not highly toxic during short-term exposures, even for zooplankton and larval organisms considered highly sensitive to a wide variety of toxicants. The advantage of the Kitsault work is that the concentration of suspended solids remained constant throughout the test; therefore, the nominal concentration is also the exposure concentration. It is likely that the effective concentrations determined with Kitsault tailings are more representative of concentrations that will be effective in the field.

The toxic effect of Kitsault tailings is attributed to primarily physical effects (Mackas pers. comm.). It is probable that physical effects would also dominate with Quartz Hill tailings since the milling process and reagent use are similar. If pilot plants results are representative, metals in the dissolved phase are expected to be at lower concentrations in Quartz Hill tailings than in Kitsault tailings (Section 2). It is therefore expected that toxicity of the dissolved phase of Quartz Hill tailings will not be greater than that of Kitsault tailings.

Bioassays with Kitsault tailings indicate suspended solids concentrations of 560 mg/l over a 40-day period are necessary before ecologically important effects are noted. Zooplankton (e.g., mysids) are often among the more sensitive organisms in bioassay testing, thus, it may be that toxic effects on other species are not likely to occur in areas with <560 mg/l suspended solids. Concentrations of suspended tailings particulates approaching 500-1,000 mg/l are unlikely to occur or persist in either fjord except near the bottom (Section 3).

Greatest toxicological concern lies with the possibility of effects from long-term, low-concentration exposures in the upper mesopelagic zone. Paffenhofer (1972) studied life-history effects of spent bauxite ore on copepods, and found adverse effects on mortality, weight, and development at a standard test concentration of 6.1 mg/l. Thus, long-term exposure to lower concentrations expected in the mesopelagic zone cannot be dismissed as a potential impact, particularly when valid chronic toxicity tests remain to be conducted. The ability to detect those kinds of impacts in field populations is impaired by temporal fluctuations in a wide array of environmental factors affecting zooplankton populations.

Bioaccumulation Potential

Bioaccumulation of metals (Cd, Cu, Mn, Mo, Pb and Fe) from Quartz Hill mill tailings was investigated over a 4-month exposure period with crabs (*Cancer magister*), clams (*Macoma balthica*), mussels (*Mytilus edulis*) and sanddabs (*Citharichthys stigmaeus*) by E.V.S. Consultants (1984b). Sediment analyses of tailings showed Cu, Pb, and Mo elevated 3, 5, and 60 times above control sediments; seawater analysis showed leaching of manganese and molybdenum from the tailings. With the exception of uptake of manganese by mussels, elevated tissue metal concentrations were not observed in test organisms exposed to tailings. No behavioral or morphological aberrations were noted; all organisms fed actively and clams and crabs burrowed readily into the sediments.

Body burdens of selected heavy metals have been evaluated in resident organisms at the marine tailings disposal sites of other mines. The most similar of these other mines, in terms of the tailings themselves and the environment into which they are discharged, is the Kitsault Molybdenum Mine on Alice Arm of Observatory Inlet, approximately 40 km east of Quartz Hill. Tailings were discharged into Alice Arm at an average rate of 12,000 tons per day in 1981 and 1982, and at about half that rate from 1968-72 (Sullivan and Brothers 1979, p. 1) when the mine was operated by B. C. Molybdenum. Substantial uptake and bioaccumulation of Pb, Cu, Zn, and Cd in the bivalve *Yoldia thraciaeformis* (an indirect deposit feeder) was found throughout much of Alice Arm within 7 months of the reopening of the Kitsault mine (Goyette pers. comm.; Goyette and Christie 1982, p. 40). McLeay and Associates (1984, p.56) also reported marked bioaccumulation of Cd, Pb, Mo and Zn in whole-body tissues of bivalve species exposed to Alice Arm sediment containing tailings, but no toxic effects were apparent. However, the organisms were not examined for sublethal toxic responses other than physical condition factor. Tissue concentrations of metals in the other organisms (including a total of four pandalid and crangonid shrimp species, three king and Tanner crab species, various flatfish species, and walleye pollock) were not

significantly different from prestartup conditions after 7 months of operation. Similarly, monitoring by Amax of Canada, Ltd. during the first production year found no evidence of increases in tissue metal levels in mussels (Mytilus edulis), cockles (Clinocardium nuttallii), shrimp (Pandalus borealis), or flatfish (Lyopsetta exilis and Hippoglossoides elassodon), but levels in Yoldia appeared to be increasing (Amax 1981 in Goyette and Christie 1982, p. 41).

In Alice Arm, a midwater tailings plume of fines developed. This was usually of relatively low concentration, but a maximum of 128 mg/l was observed (Goyette pers. comm.). It is not known, however, whether the bioaccumulation of metals observed in Alice Arm was related more to the presence of suspended particulates or to slightly elevated concentrations of dissolved metals.

Leachability testing performed with Kitsault tailings indicated that copper and lead leached more efficiently under slightly acidic conditions such as in the digestive tracts of many marine vertebrates (Goyette and Christie 1982, p. 35). Such data suggest that routes other than direct uptake of dissolved metals from the water column could result in bioaccumulation of metals from tailings by vertebrates. Ingestion of suspended tailings particulates or of contaminated food could potentially lead to metals accumulation in organisms otherwise unexposed to tailings solids or increased levels of dissolved metals.

E.V.S. Consultants (1984a, Table B-20) noted accumulations of Quartz Hill tailings solids on the antennae, uropods, thoracic appendages, and throughout the digestive tract of euphausiids (Euphausia pacifica) in all test concentrations (as low as a nominal 100 mg/l) during acute lethality bioassays. The laboratory study with Kitsault tailings (Anderson pers. comm.) noted internal accumulations of tailings solids in the guts of euphausiids and copepods. Five of the six most abundant zooplankton species in Boca de Quadra (Metridia pacifica, Euphausia pacifica, Calanus spp., Cyphocaris challengeri, and Thysanoessa spinifera, but not Parathemisto pacifica) are known to typically undergo diel vertical migration (VTN 1983b, p. 47). Similar behavior is expected in Boca de Quadra and Smeaton Bay. Euphausiids are known to be utilized directly by pollock, poachers, eelpouts, and pandalid shrimp in the deep benthic food web of both fjords (Section 4). Euphausiids are also consumed by pollock, herring, dogfish, other demersal fishes, and pasiphaeid shrimps in the mesopelagic food web (U. S. Borax 1983a, p. D-34) and by eulachon and herring in the epipelagic food web (U. S. Borax 1983a, p. D-31). Other organisms at higher trophic levels (e.g., baleen whales) may also ingest large numbers of euphausiids.

Since laboratory experiments (E.V.S. Consultants 1984a; Anderson pers. comm.) have found both internal and external accumulations of tailings solids with the zooplankton species tested to date, vertically migrating zooplankton may serve as the primary link between elevated levels of suspended solids at depth and marine vertebrates in the upper water column. Modeling (Section 3) has predicted that decreasing suspended particle concentrations are likely to occur throughout the mesopelagic zone up to the 50 m (160 ft) depth, where concentrations are expected to be 5-20 mg/l. Significant numbers of vertically migrating zooplankton organisms are, therefore, likely to encounter suspended tailings particles and could accumulate and transport them to near-surface water where predators feed. Once in the acidic environment of the vertebrate gut, metals could be leached out and absorbed into body tissues.

Uptake of toxic levels of metals by vertebrates in the upper water column is not expected. A review of a wide array of studies on contaminated sediments have shown that marine species generally do not show bioaccumulation of heavy metals, with the exception of mercury, cadmium, and copper in mussels and oysters (Anderson et al. 1987, pp. 273-274). Most vertebrates can regulate metals accumulation with metal-binding cellular proteins (metallothioneins). These proteins can control metal uptake, metabolism, and detoxification over a relatively wide range of environmental concentrations (Sanders et al. 1983). Salmon, birds, and marine mammals are likely to obtain food in areas outside of the fjord as well; thus, these organisms will be able to rapidly depurate metals to background levels. Only herring or other resident species that feed exclusively on zooplankton are likely to experience detectable increases in heavy metal levels in tissues as a result of uptake of metals through the gut.

Bioaccumulation of water soluble hydrocarbons may occur in Smeaton Bay, particularly if both tailings and wastewater from the marine terminal are discharged to Wilson Arm. Although fuel oil will occur at a concentration of only 0.015 mg/l in the tailings discharge (Table 2-5), the volume of tailings discharge results in a daily mass loading estimate of 2.2 kg (>1.8 l/d). Water soluble hydrocarbons are also expected in surface runoff and equipment washdown water from the marine terminal facility and fuel storage area. Although predischarge treatment of this runoff will occur, water soluble hydrocarbon fractions are unlikely to be removed by oil and grease separation. The total loading of dissolved hydrocarbons to Smeaton Bay is not known. Bioaccumulation of water soluble hydrocarbons is a well documented phenomenon (Malins and Hodgins 1981). Uptake from water can result in tissue concentrations as much as 1,000-fold over ambient water (Roesijadi et al. 1978). Hydrocarbons are known to adsorb readily to sediment and may often persist for years (Platt and Mackie 1980 p. 236). Biological uptake of petroleum hydrocarbons from oiled sediment is also well known

(e.g., McCain et al. 1978). Whether bioaccumulation of hydrocarbons will occur at levels that cause harm to organisms or adversely affect fish harvest quality is not clear because the loading to Smeaton Bay is not clearly understood. It is likely, however, that effects, if any, would be detectable primarily in benthos living in the vicinity of the outfall outside the deposition zone.

Biomagnification (a successive increase in body burdens of chemicals from prey to predator) is not expected unless elemental mercury were transformed to methylmercury. This transformation process would be accelerated once bacteria colonize the deposited tailings (Callahan et al. 1979, p. 14-9), but total mercury in the solids is expected to be <0.05 mg/kg (ppm). This value is within the range of mercury concentration in ocean sediments (<0.01-2 ppm) and less than the mean value (0.1 ppm) (D'Itri 1972, p. 12). Therefore, detectable biomagnification of methylmercury is not likely. Cadmium displays relatively high toxicity to marine life and is readily bioaccumulated to bioconcentration factors up to 250,000-fold for marine invertebrates (Callahan et al. 1979, p. 9-14). Biomagnification of cadmium has been reported for lower trophic levels (primary producer to grazer), but does not appear to occur at higher trophic levels (European Inland Fisheries Commission 1983, p. 14).

Potential Human Health Impacts

Herring, salmon, Dungeness crab, and shrimp occur in both fjords and are harvested in nearby fisheries. Other fishes and invertebrates may be harvested for recreational and subsistence use (Section 6). Little harvesting of deepwater benthic organisms currently takes place. During active discharge and deposition, few harvestable deepwater benthic species will be available.

Salmon would not be in contact with the liquid or solid portions of the discharge if the discharge behaves as predicted (Section 3). The most likely pathway of contamination of these harvested species is by ingesting contaminated zooplankton that migrate between relatively clean near-surface and deep waters where suspended tailings fines may be encountered. Crab, shrimp, and herring are the most likely sources of risk to humans. It is unlikely, however, that human health would be significantly affected unless: 1) high body burdens of metals developed in these species, 2) contaminated organisms appeared in significant numbers in the fishery, and 3) humans consumed large quantities of them. The likelihood of all three of these events occurring is low. The risk to human health is lowest for discharge to the

middle basin of Boca de Quadra because there is less chance of suspended solids causing adverse effects in the upper water column (Section 3).

If the discharge does not behave as predicted and a plume of fines impacts the near-surface waters, more types of organisms potentially utilized by humans would be affected, including both fish and intertidal invertebrates. Impacts on human health are more likely in this case, especially if significant increases in harvests occur. Increases in harvests are not likely to be significant in the foreseeable future (Section 6).

Upper Water Column Effects

The potential for adverse biological effects to occur in the upper water column (above sill depth and/or above the pycnocline in either fjord) will be a function primarily of the significance (concentration and areal extent) of any midwater turbidity plumes or the extent to which deposited fines may be resuspended by slumping or currents near sills or near the top of tailings piles in the inner basin or in Wilson Arm. Section 3 describes modeled characteristics of the proposed discharge and deposited solids. The modeling did not indicate a significant probability of suspended tailings particulates reaching above the pycnocline. Modeling suggests concentrations of 5-20 mg/l at depths of 50 m (160 ft) during summer (strongest stratification), and no detectable solids in the euphotic zone. However, some turbidity is expected at depths frequented by certain epipelagic species. For example, overwintering herring have been observed down to 150 m (480 ft) in Boca de Quadra (Blankenbeckler pers. comm.). Herring have been reported to avoid suspended solids concentrations of about 10 mg/l in laboratory studies (Messieh et al. 1981; Johnston and Wildish 1981). Such behavioral avoidance, if it occurs in Boca de Quadra or Smeaton Bay, could significantly lessen the usable rearing space, and thus reduce productivity of the system for this species. Juvenile salmonids, which occupy the upper 20 m of the water column, should not be directly affected by discharge to either fjord.

Indirect effects to the upper water column could occur if migrating mesopelagic zooplankton are detrimentally influenced by turbidity during diel migration. Experiments on the effects of suspended tailings on respiratory rates have shown that concentrations as low as 100 mg/l will either increase or depress respiratory rates of _Calanus marshallae_, _Euphausia pacifica_, and _Metridia pacifica_ (Anderson and Mackas 1986), which are mesopelagic species common to both fjords. Increased respiration may indicate an irritation response; depressed respiration may be a regulated response to noxious stimulation or a reflection of morbidity. This level of suspended solids could be encountered within the depth range of diel migration (100+ m). It has been

argued that increases in respiration could divert energy for growth and reproduction (Smith and Hargreaves 1984), and hence reduce population abundance. This could then affect phytoplankton abundance by changing patterns of nutrient recycling or grazing in the upper water column.

Due to the magnitude of material to be discharged, direct effects to the upper water column could be significant if the discharge does not behave as predicted. Fines <10 um diameter are expected to be discharged at a rate of approximately 14,400 tons per day (18 percent by weight of the solids) (Section 3). If tailing fines were unexpectedly distributed into the near-surface (euphotic zone) waters, a variety of impacts are possible. These include decreased primary productivity, which would impact the productivity of the epipelagic and mesopelagic food webs; turbidity or suspended solids affects on other organisms (e.g., herring, marine mammals, and migrating salmonids may avoid the area); direct affects (smothering and chronic toxicity) on intertidal and subtidal organisms; and bioaccumulation of heavy metals or process reagents (which could lead to effects on marine mammals and shorebirds).

These effects are not predicted for either fjord (Section 3). Most of the fines would remain below the outfall depth (46 m [150 ft]). Major features that may result in upper water column turbidity are turbulence over sills (especially during deepwater renewal in summer), upwelling, and weak stratification during winter. Most of these issues are discussed in Section 3. Of the three alternative discharge locations, discharge to the middle basin is least likely to result in upper water column effects because the zones of active deposition and slumping are always far below the pycnocline. For inner basin discharge or discharge to Smeaton Bay, the active zones of deposition and slumping would migrate upward as the basin fills, increasing the risk of turbidity in the upper water column.

Impacts of Tailings Disposal on Benthos

Burial of Benthic Organisms

The most obvious impact of marine tailings disposal is burial of the benthos over a large area. The time frame and extent of deposition, quantities of material, and processes resulting in the burial of the benthos have been discussed in detail in Sections 2 and 3. Impacts of benthic smothering on commercial, recreational, and subsistence harvests are addressed in Section 6. Solids deposition will occur primarily in the deep benthic zone below the 50-m (160-ft) isobath. Turbidity in the mesopelagic zone will result in some additional deposition of

suspended solids along the sides of the fjord basin. The loss of benthic biota would occur rapidly relative to the duration of the active disposal (55 yrs).

Under the Boca de Quadra inner basin disposal option, benthic smothering would occur in two major phases. The first would occur during the spreading of tailings over 450 hectares (1,100 ac) of the inner basin bottom. Most of this area is expected to be covered by deposited tailings within 1.5 years (U.S. Borax 1983a, p. D-73). The second major phase would occur after approximately the tenth year of discharge when tailings are expected to begin spilling over the inner sill into the middle basin. The majority of 1,600 hectares (4,000 ac) of the middle basin bottom would be covered within 18 years (U. S. Borax 1983a, p. D-74). The remaining 30-45 years of discharge would not result in major new areas receiving deposition. Rather, depth of deposition would increase throughout the discharge life.

If tailings were discharged only into the middle basin of Boca de Quadra, deposition that occurred during the first 18 years over 1,600 hectares would cause the majority of benthic smothering. Turbid water from the middle basin would spill over the inner sill during deepwater renewal periods and cause increased sedimentation in the inner basin (Section 3). Although sedimentation in the inner basin could approach a maximum rate of 30 cm/yr, turbid water is expected to enter the inner basin only seasonally so that actual deposition is not expected to exceed 15 cm/yr and may be as low as 4 cm/yr (Section 3). The presence of two downfjord sills (Kite Island and outer sills) would effectively isolate suspended solids within Boca de Quadra fjord.

Discharge into Smeaton Bay would fill the fjord basin in two phases. During the first 4 years of operation, the tailings would fill the Wilson Arm basin. The discharge would then begin to fill the basin of Smeaton Bay, reaching the base of the deep middle sill within 12 years and filling the entire basin to within 45 m (145 ft) of the top of the outer sill in 55 years. Because the outer sill is below the level of the pycnocline, suspended fine tailings would advect into Behm Canal.

Rhoads (1974) reviewed the literature regarding animal/sediment relationships in soft-bottom marine habitats and suggested that suspension feeders (e.g., some polychaetes, some bivalves, and ophiuroids) are generally excluded from turbid environments. This can be due to either their feeding apparatus becoming clogged with suspended particles or because eggs and larvae cannot survive in such habitats. By contrast, deposit feeders do not show the same negative effects from increased turbidity because they do not rely upon filtration for food acquisition. Moreover, Rhoads (1974, p. 295) states that it is reasonable to expect that eggs and larvae of infaunal mud dwelling species will be minimally affected by increased

turbidity. Thus, the strongest negative effects of increased turbidity near zones of active deposition or slumping should be exerted on suspension feeders and may result in their exclusion from some areas below the pycnocline.

Deposition of 15 cm of tailings per year in the inner basin as a result of middle basin discharge could be important to some infaunal species. Much of the deposition is expected to occur during the summer (deepwater renewal) when many species are at peak abundance. Larvae and juveniles of small infaunal organisms that do not readily burrow may be particularly susceptible. Effects of smothering benthic invertebrates with mill tailings were examined by VTN (1983a, p. 12) in the inner basin of Boca de Quadra. The mid-depth benthic assemblage (Table 4-2) resides at this depth (95 m [310 ft]). Resident infaunal assemblages were sampled using a 0.1 m^2 Van Veen bottom grab. The upper portion of each grab sample was removed, placed in a 30 x 30 cm plastic tub, and covered with a prescribed thickness of mine tailings (2, 4, or 8 cm). The authors do not describe the source or characteristics of the tailings. Control samples were treated identically, except that they were not covered. The plastic tubs were then placed in racks, lowered to the bottom of the fjord, and retrieved after either 5 days or 3 months. Upon retrieval, overlying tailings were separated from the ambient sediments underneath, and organisms in each fraction were sieved through a 1-mm screen, preserved, and identified.

Smothering data were analyzed in two ways. First, raw densities of all species in tailings and underlying sediments were determined. However, these data included recently settled, as well as smothered, specimens. A second method of analysis was designed to separate these two types of organisms. Only polychaetes were sufficiently abundant to be included in the second analysis. Size of individual polychaetes was measured and those individuals considered too small to have been present at the beginning of each experiment were removed from the analysis.

Results of the smothering experiment after 5 days duration suggest that most organisms in the overlying tailings had settled during the experiment and that few had migrated up into the tailings from underlying sediments (VTN 1983a, pp. 41-43). Results after 3 months duration are similar, except that the polychaete Polydora socialis was relatively abundant in overlying tailings. For both experiments, a larger number of organisms and species were generally found in the underlying sediments than in the tailings. For the 3-month experiment, polychaete species in underlying sediments were inversely related to depth of tailings, ranging from nine species in control samples to three species under 8 cm of tailings.

These smothering experiments suggest that although a number of polychaete species may survive burial by tailings up to 8 cm deep, few are likely to crawl up through the tailings (VTN 1983a, pp. 41-43). A notable exception was Polydora socialis. Other species found in control samples but not in tailings or underlying sediments either did not survive burial or crawled to the surface and died. The implication of these conclusions is that most colonization of benthic assemblages smothered with mine tailings should come from either larval settlement or lateral migration of organisms.

The effects of smothering would be most acute near flow channels of discharged material. The flow of discharged material behaves much like a meandering river, as it periodically shifts its course in response to changes in bottom slope, ambient current, etc. Therefore, it is conceivable that some benthic colonization could occur within localized areas of the bottom at a distance from the flow channel. However, no information exists comparing the rate of colonization to the rate of change in the location of active tailings deposition or density current flow. It seems unlikely that many species would settle and survive within the very turbid benthic environment created by discharge, even away from the channel flow.

Ellis (pers. comm.) observed the effects of mill tailings deposition at Island Copper on burrowing activity. The observations were made from a submersible vehicle. In areas of light tailings deposition (1-2 cm), a large number and variety of burrow holes were seen, resembling a natural benthic community. In areas of moderate tailings deposition (5-10 cm), a dramatic decline in burrow diversity was found. Virtually all burrows in these areas were made by the burrowing anemone Pachycerianthus fimbriatus(?). In areas of heavy tailings deposition (>60 cm), there were no signs of deep-burrowing organisms. These observations suggest that tailings deposition inhibits the establishment and maintenance of deep-burrowing infaunal populations. It is not clear whether deep-burrowing organisms were smothered or if burrowing capabilities were altered by density characteristics of the tailings.

Alteration of Community Structure and Productivity

After discharge and tailing deposition ceases in an area, colonization of the sediment by infaunal and epibenthic organisms may take place. Because large areas will be affected, immigration from the fringes of the depositional area is not expected to be a major route of colonization. Initial colonization will be primarily a function of the settlement of larvae of benthic organisms. The species composition and abundance of colonizing communities will depend upon several abiotic and biotic factors, including 1) sediment characteristics (grain size, organic content and chemical traits), 2) depth, 3)

availability of larvae as a function of seasonal reproductive patterns and distance from the larval source, 4) sediment preferences of larvae, and 5) tolerances of newly settled individuals to the benthic environment. Initial colonizers will tend to be those with high reproductive potentials and tolerances to the tailings' physical/chemical characteristics. Eventually, however, mill tailings will be covered by fluvial and organic deposits such that the substrate will be similar to predischarge conditions. Since depth is significantly correlated with infaunal and epibenthic species composition, there may be permanent changes in community structure if changes in bathymetry are significant. Substantial changes in community structure are expected in Smeaton Bay or if discharge is made to the inner basin of Boca de Quadra; habitats that now support deep or mid-depth benthic assemblages will be transformed into mid-depth or shallow benthic community habitat.

Few studies have been conducted on the potential for colonization of mill tailings. Investigations at the B.C. Molybdenum mine on Alice Arm in British Columbia (now operated as Kitsault Mine) found substantial increases in the number of species and individuals in impacted areas 1 year after deposition ceased. However, the abundance of species and individuals was still significantly reduced in the deepest, most impacted areas. Furthermore, cluster analysis indicated that species composition varied with distance from discharge. More specifically, the trophic diversity (number of feeding groups) increased with increasing distance from the discharge (Kathman et al. 1984). Thus, initiation of colonization may be relatively rapid and result in significant increases in biomass or species diversity within 1 year, but more time will be needed to obtain a benthic community indistinguishable from a comparable area not experiencing deposition.

To examine effects of Quartz Hill mine tailings on colonization of benthic assemblages in Boca de Quadra, VTN (1983a, pp. 6-12) conducted a series of colonization experiments in conjunction with the smothering experiments previously described. Stations were located at depths of 95, 150, and 210 m, corresponding to the shallow (310 ft), mid-depth (490 ft), and deep (690 ft) benthic invertebrate assemblages respectively (Tables 4-2 and 4-3).

At each station, a stainless steel rack holding fifty-four 10 x 10 cm plastic containers were lowered to the bottom. The containers were filled either with frozen, ambient sediments (animals not removed) or with tailings supplied by U. S. Borax. The authors do not describe the characteristics of the tailings. Following initial deployment, individual containers were added and removed periodically to follow colonization trends. Upon retrieval, sediments were sieved through a 1-mm screen, and retained material was preserved and identified. Control samples

were taken from around the racks at each station throughout the study using a 0.1 m^2 Van Veen grab. Control data represented natural fluctuations in nearby benthic communities and were compared with fluctuations noted in the colonization experiments.

Community analyses indicated that many species found in control samples settled in the experimental samples within 1 year. These colonizers included primarily polychaetes and crustaceans, but molluscs were notably lacking. Colonization patterns indicated that each sample was colonizing in the direction of the control samples. Colonization was approximately 70 percent more rapid in previously frozen sediment from each site than in tailings. Shallower stations colonized more quickly and to a greater extent than deeper stations. Tailings at all but the deepest station showed fastest rates of colonization in the spring.

Settlement, based on numbers of species, was lower at 210 m than at 150 and 95 m. The total number of species and specimens settling was relatively uniform throughout the annual cycle at 210 m, whereas settlement peaked from winter through summer at 95 m and peaked in spring and fall at 150 m. With respect to tailings, fewer species were found than in control sediment at 95 m, but negative effects of tailings were not as strong at other depths. In fact, more species were found in tailings than in control sediments at 150 m.

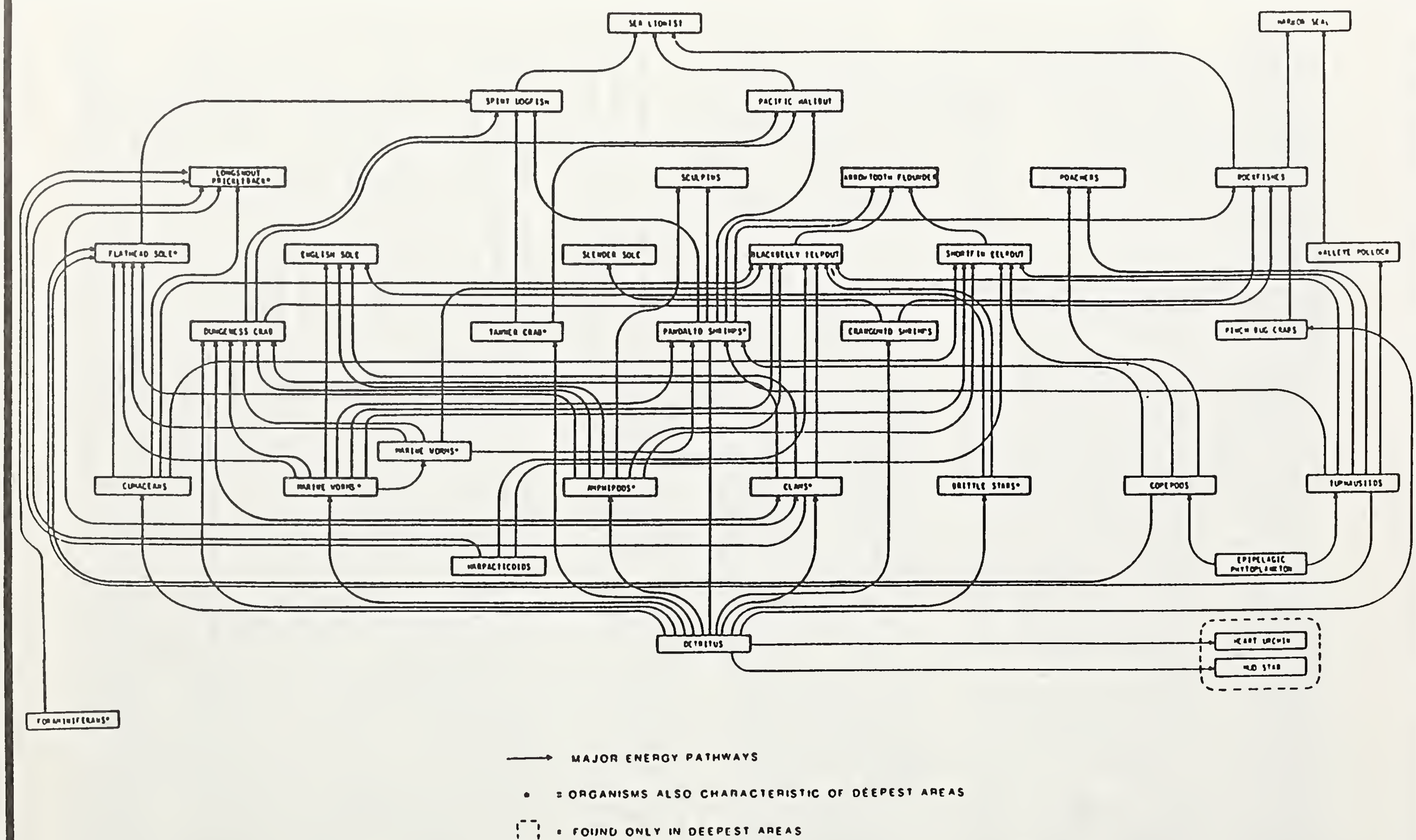
The study was not carried out long enough for any of the treatments to become indistinguishable from the controls. It is difficult to predict from the existing data the complete recovery time of the benthic community. VTN (1983a, p. 36) estimates 6-25 months would be required, based on linear extrapolation of the short-term colonization rates. Actual recovery, however, may require more time for several reasons. First, colonization rates differed seasonally; therefore, linear extrapolation may underestimate overall recovery time if based primarily on data from the spring. Second, the recolonizing organisms differed in some important ways from the controls; for example, bivalve species were lacking in the experimental samples. VTN (1983a, pp. 25-26, 30) assumed that bivalves would recolonize later, but how long this might take cannot be inferred from the data. Third, the experimental racks were surrounded by undisturbed benthos; therefore, a nearby source of larvae was present. When major areas of the bottom are covered by tailings from the mine, large portions of the unoccupied space will be relatively distant from sources of larvae. The actual rates of colonization will, therefore, be much more dependent on oceanographic conditions and behavioral characteristics of larval stages of various species.

The effect of changes in bathymetry on productivity and species composition in these fjords is difficult to predict. However, it is possible to assess relative impact, depending on

the location of discharge. An inner basin discharge in Boca de Quadra would eliminate the mid-depth habitat (100-200 m) by raising the bottom to sill depth. The spill of tailings into the middle basin would also affect deep benthic habitat during the discharge period, but it would be expected to recover when deposition ceased. A significant decrease in inner basin depth could possibly enhance productivity after cessation of the discharge by increasing vertical mixing of nutrients and bringing the benthos into a warmer, more productive zone of the water column. For example, since Dungeness crabs are more abundant in shallow areas, this could increase their abundance. The species composition of the inner basin would be altered with the elimination of the mid-depth infaunal assemblage.

The effects of discharge into the middle basin of Boca de Quadra would be less pronounced than an inner basin discharge or discharge to Smeaton Bay. After tailing deposition ceased, the below-sill volume of the middle basin would have been reduced by 20 percent, but the range of depth would not have been altered. Hence, the deepwater infaunal assemblages characteristic of this basin would eventually return. The advection of some suspended tailings into the inner basin may cause some loss and alteration of the mid-depth assemblage; however, the loss would not be as rapid or as complete as that under direct discharge to the inner basin. Small crustacean (e.g., cumaceans, copepods) and some polychaete and clam populations may be reduced. Organisms that feed on them (Figure 5-1) may also be affected by reduced food supplies. Tolerant species could survive a depositional rate of a few cm/yr. Discharge to the middle basin is expected to have no effect in the outer basin or oceanic areas at the mouth of Boca de Quadra due to the isolating influence of the Kite Island and outer sills.

Discharge into Smeaton Bay could have significant effects on productivity and species composition of benthic communities. At the end of the discharge period, the basin of this fjord would be almost filled to sill depth (140 m [460 ft]). Deep soft-bottom areas would be eliminated, and the fjord would become a relatively shallow embayment with almost no physical separation from Behm Canal. Only a small basin behind a small sill less than 45 m (150 ft) high would remain. This could potentially enhance productivity of this bay, and species composition would be substantially and permanently altered for several reasons. First, the habitat for deep infaunal assemblages would be eliminated. Second, changes in seasonal patterns of nutrient cycling associated with the loss of the basin-and-sill ecosystem could have unknown effects on community structure. Third, although the biological effects of the enclosure of bottom waters are not well known, there is some evidence that the development of fjord communities is affected by the curtailment of the free exchange of planktonic larvae between fjords and open coastal waters (Pearson 1980). The available information on the recovery



SOFTBOTTOM BENTHIC FOOD WEB

FIGURE 5-1

SOURCE: VTN 1983b, Figure 5.3-6

of benthic communities following cessation of discharge in Alice Arm, B.C., is of limited value in assessing potential long-term impact associated with the complete elimination of a fjord's basin-and-sill configuration. During the discharge period, suspended solids will be advected into Behm Canal. However, according to computer modeling the concentrations of solids are projected to be low. The impact of the exported solids on benthic productivity or community structure outside of Smeaton Bay would depend upon the nature of the benthic communities, which presently is an unknown.

Effects on Higher Trophic Levels

Marine birds and marine mammals are potentially impacted if food resources or habitat are altered. Several factors must be considered in assessing risk:

- Boca de Quadra inner basin and Wilson Arm, respectively, are rich foraging areas near the Keta River and Wilson estuaries, which are major bird habitats.

- Some sea ducks dive to forage on fish and benthos.

- Exposure to elevated levels of heavy metals from contaminated zooplankton is possible.

It is not expected that marine birds will directly encounter turbid water. Most birds forage to depths <20 m (66 ft), whereas most suspended solids are expected to remain below the outfall depth (46 m). Seals and other marine mammals can forage at greater depths.

Of greatest concern is the potential reduction in the herring population and subsequent effects on seals and piscivorous birds such as mergansers and cormorants. It is not possible to determine whether herring abundance will significantly change in Boca de Quadra and Smeaton Bay. The keys to this are whether turbidity levels causing avoidance, and resulting in loss of foraging and overwintering habitat, will occur at depths frequented by herring.

Discharge to the middle basin appears to threaten marine birds and mammals less than discharge to the inner basin or Smeaton Bay for several reasons:

- It appears that Boca de Quadra inner basin and Wilson Arm support larger quantities of demersal fish and benthic prey relative to the Boca de Quadra middle basin and deeper portions of Smeaton Bay. These shallower areas are also in reach of most diving birds

and mammals. It is expected that discharge to the middle basin would have relatively less impact on food sources of upper trophic levels.

- The Boca de Quadra inner basin and Wilson Arm are adjacent to important bird habitat in the Keta and Wilson River estuaries; the middle basin is farther away.

- If discharge is to the inner basin of Boca de Quadra or to Smeaton Bay, the areas of deposition and slumping would move closer to the water surface as the basin fills. Thus, the major sources of turbidity move closer to the surface. Even after the bulk of the solids spill over into the middle basin of Boca de Quadra, deposition of fines is expected to continue upfjord in the inner basin. In contrast, sources of high turbidity will remain in deep water throughout the project if discharge is made directly to the middle basin.

Comparison of Alternatives

Within Boca de Quadra, similar types of biological impacts may result, but the alternatives differ as to the magnitude and significance of various impacts. Potential effects from toxicity and bioaccumulation would be reduced under the middle basin alternative in that fewer organisms would be exposed to the highest concentrations of tailings solids or dissolved toxicants. Biota in only one basin would be exposed to discharge, in contrast to inner basin discharge where biota from both basins are exposed. The risk of upper water column effects would be reduced with middle basin discharge since tailings would not be forced to spill over the more dynamic area of the inner sill or approach the range of the pycnocline.

Direct smothering of the benthos will occur over a larger area when tailings are deposited in both basins. If deposition only occurs in the middle basin, benthic life in the inner basin will persist (although species composition may be altered in some areas due to increased sedimentation rates) and colonization of the middle basin could be accelerated due to sources of spawn existing on both sides (i.e., outer and inner basins).

It is believed that the potential for adverse impacts on waterfowl would be lessened under the middle basin option in that the tailings would be least likely to impact the Keta River estuary at the head of Boca de Quadra.

Finally, the depth of the inner basin would not be significantly altered if discharge is made to the middle basin. If discharge to the inner basin were to occur, bathymetry of the inner basin would be permanently altered, and the benthic community would never return to predischarge conditions. Bathymetry changes in the middle basin under either alternative are not expected to result in permanent replacement of a deep benthic assemblage by a more shallow assemblage. The greatest potential for the most complete recovery (relative to predischarge conditions) of the diversity and productivity of the benthic community is, therefore, achieved under the middle basin discharge alternative.

In comparison to the Boca de Quadra discharge sites, Smeaton Bay is somewhat shallow. Discharge to Smeaton Bay would have significant and permanent effects on benthic productivity and composition of benthic communities because it would become a relatively shallow embayment with no remaining deepwater infaunal habitat and essentially no physical separation from Behm Canal. Fish and benthic invertebrate species in Wilson Arm are relatively abundant and would be displaced or smothered by discharges to Smeaton Bay. The amount of bottom area covered by substantial deposits of tailings is comparable to that for discharge to the middle basin of Boca de Quadra.

Discharge to Smeaton Bay is comparable to discharge to the inner basin of Boca de Quadra in the degree of risk it poses to the upper water column. In both situations, the top of the tailings pile occurs above the 100 m isobath as the basin reaches capacity. Active deposition and slumping events, therefore, will occur in areas of the fjord that are known to be above the pycnocline during certain times of the year. The potential for mixing of suspended solids in the upper 100 m of the water column, therefore, is expected to be greater for discharge to Wilson Arm or inner basin Boca de Quadra than for discharge to the middle basin of Boca de Quadra.

Section 6

COMMERCIAL, RECREATIONAL, AND SUBSISTENCE HARVESTS

Summary

A valuable herring-roe fishery occurs at the mouth of Boca de Quadra; the herring fishery is one of the largest in southeast Alaska. An estimated 955,000 and 269,000 salmon per year are harvested from Smeaton Bay and Boca de Quadra salmon stocks, respectively. Harvests of shellfish and demersal fish are limited, although a small pot fishery for shrimp and Dungeness crab occurs throughout Boca de Quadra and Smeaton Bay. Both fjords have the potential for supporting shellfish and demersal fish harvests, particularly in the more shallow areas at the heads of the fjords or side arms. Although subsistence and recreational fishing occurs in both fjords, most recreational and subsistence harvests in the area occur closer to populated areas.

Salmon generally inhabit the upper 20 m and should not be directly affected by mill tailings discharges. The food chain leading to juvenile salmonids may potentially be affected when tailings deposition or mass slumping events occurs above the pycnocline near the end of the project.

Discharges to the inner basin of Boca de Quadra could significantly affect potential harvests of shrimp in the inner and middle basins and existing harvests of Dungeness crab in the inner basin. If herring avoid suspended sediment concentrations of more than 10 mg/l, turbidity in the lower depth range of herring habitat could cause displacement of the large population of herring that inhabit the fjord year-round.

Discharge to Smeaton Bay would have effects on potential and existing harvests of shrimp and Dungeness crab similar to those for discharge to the inner basin of Boca de Quadra.

Discharge to the middle basin of Boca de Quadra would be less likely to affect harvests than the alternative discharges because: 1) less total bottom area would be adversely affected, 2) the more productive shallow bottom habitat of the inner basin and Wilson Arm would be affected less, and 3) elevated levels of suspended solids and tailings deposition above the 100 m isobath is less likely.

Commercial Harvests

Although Boca de Quadra and Smeaton Bay are productive habitats for fish and shellfish resources, fishing within the fjords has not reached its potential. Fishing for bottomfish such as rockfish and flatfish may occur periodically but is limited because bottom substrate is generally unconducive to bottom trawling, and alternative fishing grounds exist closer to Ketchikan and other ports (House pers. comm.). As fishermen seek new and productive fishing grounds, fishing pressure in Boca de Quadra and Smeaton Bay may increase along with overall fishing activity in the Ketchikan area.

Biomass estimates of the commercially important demersal species have been estimated by Envirosphere (1984, Table 4-12) for Boca de Quadra and Smeaton Bay (Table 6-1). Although these estimates may be useful for relative indices of biomass, care must be taken to not consider them as absolute biomass estimates because: 1) estimates are based on otter trawl data that must be considered subject to extreme bias, and 2) obtaining accurate biomass data using an otter trawl in areas with bathymetric conditions as found in Boca de Quadra and Smeaton Bay is difficult at best. For a complete list of assumptions and methods employed for calculating the biomass estimates, refer to Envirosphere (1984, Appendix G).

Although a sizable purse seine fishery for salmon occurs in the outer basin of Boca de Quadra, direct estimates of the harvest are not available (Envirosphere 1984, Table 3-10). Harvests of salmon originating from Boca de Quadra and Smeaton Bay occur throughout the Ketchikan area as the salmon return to their spawning streams. Since 1975 an average of 9 million pink, 500,000 chum, 400,000 coho, 435,000 sockeye, and 77,000 chinook salmon have been harvested each year in the Ketchikan area (Table 6-2). Of these salmon, an estimated average of 955,000 and 319,000 salmon per year were from Smeaton Bay and Boca de Quadra, respectively. Smeaton Bay salmon are estimated to represent from 3-10 percent of the Ketchikan area harvest, depending on species, whereas Boca de Quadra salmon represent from 1-7 percent of the total harvest (Table 6-2). These estimates of harvested fish may be low because not all of the salmon-producing streams entering the fjords were considered in the evaluation and because 20-33 percent of the salmon escapement surveys were incomplete. Harvests of salmon destined for Smeaton Bay may increase in the near future because of a 5-year salmon enhancement program initiated in 1985. This program consists of stocking the Bakewell Lake system with 600,000 - 700,000 sockeye fry per year (Novak pers. comm.). Smeaton Bay currently is closed to chinook salmon fishing in an effort to restore the runs.

Table 6-1. Standing Stock (kg) Estimates of Important Demersal Species Potentially Affected by Tailings Discharge[a]

	WALLEYE POLLOCK	ROCKFISH	FLATFISH	DUNGENESS CRAB	TANNER CRAB	POT SHRIMP[b]	TRAWL SHRIMP[c]
Boca de Quadra							
Inner basin	2,113	87	8,320	2,078	696	1,201	7,388
Middle basin	1,836	1,667	721	921	599	264	1,734
Smeaton Bay	1,846	67	12,082	2,608	7,304	1,450	17,863

[a] From Envirosphere 1984; Table 4-12. Assumptions and methods used to calculate the biomass estimates are listed in Envirosphere 1984; App. G.
[b] Pot shrimp = spot and coonstripe shrimp.
[c] Trawl shrimp = sidestripe, ocean, and pink shrimp.

Table 6-2. Commercial Catch of Salmon from the Ketchikan Area

	YEAR	CHINOOK	COHO	PINK	CHUM	SOCKEYE
A. Ketchican Area Harvests[a]						
	1975	116,456	210,814	2,395,203	325,842	77,612
	1976	83,910	226,024	4,343,006	485,826	238,400
	1977	50,267	270,738	8,335,833	375,384	519,986
	1978	82,309	543,122	16,384,091	613,292	404,205
	1979	84,020	393,197	4,142,402	266,083	468,313
	1980	52,513	397,223	13,335,800	790,773	620,504
	1981	61,054	501,608	12,225,525	295,182	521,795
	1982	87,476	657,796	12,631,692	815,479	631,165
Average		77,251	400,065	9,224,194	495,983	435,248
B. Harvests of Boca de Quadra Salmon[b]						
Estimated Average		2,769	5,797	209,124	51,559	50,000[c]
Percent of Total Fishery		3.6	1.4	2.3	6.8	11.5
C. Harvests of Wilson Arm/Smeaton Bay Salmon[b]						
Estimated Average		2,479	16,273	922,511	13,481	ND
Percent of Total Fishery		3.2	4.1	10.0	2.7	ND

[a] Number of fish. Includes Annette Island harvests.
[b] These estimates are based on numerous assumptions.
[c] Harvest of sockeye based on 80% harvest rate of the Hugh Smith Lake stock.
ND No data available.

SOURCE: Envirosphere 1984, Table 3-10, Appendix G, Table 3-1; House pers. comm.; Peltz pers. comm.

The mouth of Boca de Quadra and vicinity has been the location of a major herring-roe fishery in southeast Alaska since 1975. Gill net harvests of mature herring have increased from 424 to 3,239 mt in recent years (Table 6-3). The annual monetary value of herring harvests since 1984 have been approximately $1.6-3.3 million (House pers. comm.). Herring are harvested by setting stationary gill nets near the shore during late March/early April when mature herring are returning to spawn. Although fishing for herring does not occur within either fjord, juvenile herring utilize Boca de Quadra and, perhaps to a lesser extent, Smeaton Bay as a rearing habitat.

A Dungeness crab and shrimp fishery occurs in Boca de Quadra and periodically in Smeaton Bay. On average, 1,057 kg (2,325 lbs) of crab and 867 kg (1,907 lbs) of shrimp are taken each year in Boca de Quadra for an exvessel value of $2,232 and $6,655, respectively (Table 6-4). Peak harvest years have brought in $5,900 and $47,500 for crab and shrimp, respectively. In contrast, only 184 kg (404 lbs) of shrimp per year are taken from Smeaton Bay for a total yearly value of $1,945. Both crab and shrimp are harvested with pots. Primary fishing grounds for crab are at the mouth of Mink Arm and at the heads of bays, e.g., Mink Arm, Marten Arm, the inner basin of Boca de Quadra, Wilson Arm, and Bakewell Arm. Shrimp are harvested in areas of precipitous drop-off such as the mouths of Boca de Quadra, Mink Arm, and Smeaton Bay. Presently only spot and coonstripe shrimp are harvested because of difficulties of trawling in the fjords for pink, ocean, and sidestripe shrimp.

Biomass estimates of Dungeness crab and shrimp for both fjords are presented in Table 6-1. Again, caution must be taken when using these estimates. They are appropriate only as relative indices of biomass for the purpose of within-fjord and between-fjord comparisons.

Tanner crab, also of commercial importance, are abundant in Boca de Quadra and Smeaton Bay, but most are less than legal size (140 mm) (Envirosphere 1984, pp. 3-77). Biomass estimates of tanner crab for both fjords are presented in Table 6-1. Biomass of juveniles in Boca de Quadra trawl samples (<110 mm carapace diameter for males and <88 mm carapace diameter for females) was significantly greater than adult biomass (VTN 1980, p. 132, Figure 4-3-20). The dominance of juvenile Tanner crab in Smeaton Bay was not as great (VTN 1981b, Figures 4.3-33-36). Presently Tanner crab are not harvested in either fjord. Harvests of Tanner crab in the Ketchikan area are small, 680 kg/yr (1,500 lb/year [Envirosphere 1984, pp. 3-80]) relative to the entire southeast Alaska catch of 1.8 million kg (4 million lbs) in 1980 (ADFG 1982).

Table 6-3. Commercial Herring Harvests Near the Mouth of Boca de Quadra and Vicinity (Kah Shakes Cove), 1976-84

YEAR	HARVEST (METRIC TONS)	QUOTA (METRIC TONS)
1975	No Fishery	-
1976	424	300
1977	820	800
1978	170	680
1979	528	585
1980	1,140	1,110
1981	1,840	1,550
1982	2,279	1,900
1983	3,239	2,500
1984	2,100	2,100
1985	2,160	2,300
1986	1,538	1,100
1987	1,440	1,200
1988	850	950

SOURCE: House pers. comm.

Table 6-4. Estimated Commercial Catch of Shellfish in Boca de Quadra and Smeaton Bay[a]

YEAR[b]	DUNGENESS CRAB (lbs) Boca de Quadra	Smeaton Bay	SHRIMP (lbs) Boca de Quadra	Smeaton Bay
1969	0	0	0	1,280
1970	324	0	4,054	0
1971	2,059	0	815	2,190
1972	2,164	0	1,190	165
1973	4,523	0	0	0
1974	1,765	1,020	0	808
1975	5,315	1,036	0	0
1976	0	0	538	465
1977	4,951	2,615	0	25
1978	852	1,088	0	0
1979	1,996	188	1,380	412
1980	3,270	112	13,609	32
1981	1,486	--[c]	4,612	--
1982	6,172	--	1,211	1,314
1983	--	--	1,196	--
Average	2,325	404	1,907	446
Value[b]	$2,232	$388	$6,655	$1,557
Peak	6,172	2,615	13,609	2,109
Value[b]	$5,925	$2,510	$47,495	$7,643

[a] Harvest values may be low because of incomplete reporting of catch specific to Boca de Quadra or Smeaton Bay.

[b] Based on value of $0.96/lb for Dungeness crab and $3.49/lb for shrimp.

[c] No reported catch.

SOURCE: Envirosphere 1984, Appendix G, Tables 7-1 and 7-2.

The importance of Boca de Quadra and Smeaton Bay as a spawning and rearing habitat for Ketchikan area Tanner crab is not likely to be significant. Both juvenile and adult Tanner crab have been taken from the fjords. Migration data from Kodiak Island suggest Tanner crab spawn and rear in bays such as Boca de Quadra or Smeaton Bay, then the males move offshore (Donaldson pers. comm.). However, migration distances of these crab were generally less than 24 km, considerably less than the length of Boca de Quadra (50 km) but similar to the length of Smeaton Bay (24 km). Tanner crab are not known to undergo seasonal or ontogenic migrations, such as the migrations by king crab in the Bering Sea (Somerton pers. comm.). It is possible that Smeaton Bay and Boca de Quadra may contribute to Tanner crab stocks in Behm Canal and the Revillagigedo Channel, but this contribution is not likely to be significant.

Subsistence Harvests

Subsistence harvests are important culturally and as a food source to native Americans throughout southeast Alaska. Although subsistence harvests occur in Boca de Quadra and Smeaton Bay, other areas closer to town are utilized more frequently (House pers. comm.). Species that are harvested for subsistence purposes in both fjords include herring roe on kelp, whole herring, shrimp, crab, flatfish, and rockfish. Some salmon are harvested, although Alaska Department of Fish and Game (ADFG) encourages subsistence fishermen to fish in other areas.

Subsistence harvests occur primarily during spring and summer. Catch statistics are not available for most species, although 148 sockeye salmon were taken from Hugh Smith Lake in 1984 (Larson pers. comm). It is likely that harvesting will increase as fishermen seek new and productive areas.

Recreational Harvests

Although Boca de Quadra and Smeaton Bay contain substantial sportfish resources, utilization of the area by sportfishermen is not great because of the distance from population centers. Nevertheless, both fjords provide a significant source of recreation for sportsmen willing to travel long distances.

Fishing for salmonids is the main activity of sportfishermen in Boca de Quadra and Smeaton Bay. Humpback Creek near Mink Arm is known for large and abundant steelhead trout (Doherty pers. comm.). Coho salmon, steelhead trout, and sea-run cutthroat trout are taken by fishermen at the Hugh Smith Lake area near Marten Arm. Salmonids such as sea-run cutthroat, Dolly Varden, steelhead, and coho are caught at the Keta and Marten Rivers, although sportfishing at these rivers is less than at other

rivers near the mouth of Boca de Quadra because of the distance from Ketchikan. Less numbers of steelhead and sea-run cutthroat trout are captured in Smeaton Bay (Siedelman pers. comm.). Sportfish catch records for salmonids, marine fish, and shellfish in the Ketchikan area are shown in Table 6-5. Approximately 80-108 chinook salmon and 35-172 coho salmon returning to Quartz Hill streams are taken annually (Envirosphere 1984, pp. 3-63). Catch records specific to Boca de Quadra and Smeaton Bay are not available for other species.

Other fish and shellfish are harvested by sportfishermen in the two fjords. Good fishing areas for halibut and rockfish are in the outer basin and near the mouth of Boca de Quadra (House pers. comm.). Dungeness crab and shrimp are taken occasionally, probably at locations similar to the commercial harvest.

Comparison of Alternative Discharge Locations

Effects of Boca de Quadra Inner Basin Discharges on Harvests

Effects on Harvest Quantity. A significant commercial fishery does not presently exist in Boca de Quadra, and most sport and subsistence fishing occurs in the outer portion of Boca de Quadra. There are, however, significant fish and shellfish resources in the fjord that potentially could be harvested. Herring and salmon that use Boca de Quadra at some point in their life history may contribute in an important way to the existing regional fishery. Thus, discharge to Boca de Quadra inner basin has the potential to impact existing and potential commercial, recreational, or subsistence harvests.

Salmon would be directly impacted only if impacts from mill tailings discharge occur in the upper 20 m (66 ft) of the water column or in estuarine habitats. Since these are not expected with discharge to Boca de Quadra (Section 3), significant impacts on salmon fisheries should not occur as a result of mill tailings discharge. There is a possibility that juvenile salmon could be affected if their zooplankton food supply was reduced, and this might have some minor effects on fisheries. Discharge of tailings to the inner basin will create a tailings pile whose peak would reach 70-80 m below the surface. During the period in which turbidity flow channels to the middle basin are still being established, slumping and other mass movement events are likely to inject suspended fines into the depth range of zooplankton that contribute to juvenile salmon diets. The critical period for these potential indirect effects is likely to be limited to the later stages of filling the inner basin, and is expected to be less significant once channels carrying turbidity currents to the middle basin are well established.

Table 6-5. Ketchikan Area[a] Sportfish Harvest (Number), 1979-82

SPECIES	YEAR 1979	1980	1981	1982
Chinook	4,165	5,415	5,683	6,215
Coho	2,336	6,914	5,132	11,442
Sockeye	291	361	54	126
Pink	4,728	15,885	8,200	17,238
Chum	72	293	634	230
Steelhead	290	748	480	773
Cutthroat (searun)	ND	ND	ND	577
Dolly Varden (searun)	ND	ND	ND	503
Halibut	1,359	5,260	4,634	5,963
Rockfish	8,491	18,415	20,581	21,023

[a] Ketchikan area (Area A): All waters from Portland Canal to Ernest Sound, including Duke, Annette, and Gravina Islands and associated waters.

ND - No data available.

SOURCE: Mills 1983.

Some impact on demersal fish populations in Boca de Quadra is likely because of tailings deposition and increased turbidity in deep habitats during the discharge. Discharge to the inner basin also will permanently modify the benthic community in the inner basin (Section 5) to a shallow benthic assemblage. The magnitude of the impact will be greater for discharge to the inner basin than for middle basin discharge because two basins are disturbed rather than one, and the benthic community type in the inner basin will be permanently altered. Nevertheless, the significance of this impact for current and future harvests is judged to be low. It is doubtful that commercial bottomfishing would be established in a significant way in Boca de Quadra because of the bottom conditions. The contribution of Boca de Quadra bottomfish to harvests outside the fjord is unknown, but is likely to be minor. Based on depth preferences from other areas, species such as rock sole and English sole could benefit from conversion of 450 hectares (1,100 ac) of bottom habitat into a more shallow benthic community, whereas others such as rex sole, flathead sole, and halibut could decline in number. The magnitude of benefit or loss cannot be calculated, however, because the stock estimates (Table 6-1) are useful only for relative comparison between basins.

Discharge to the inner basin eventually will fill the basin to a depth that overlaps with the known distribution of overwintering herring as well as with the pycnocline. Juvenile, overwintering herring are known to lie on the bottom during the day at depths of 125-150 m (410-490 ft) and rise into the overlying water column at night (Blankenbeckler pers. comm.). Laboratory tests indicate herring may avoid suspended sediments at concentrations as low as 10 mg/l, although herring in the wild may have different tolerance levels (Johnston and Wildish 1981). Thus, there is some concern about the effects of turbidity and habitat displacement on herring (Section 5).

Estimates of the contribution of herring in Boca de Quadra to the herring fishery in the area have been made based on a population estimate of 980,000 age-1 herring in the inner basin. (This population estimate of 980,000 was based on one survey during one winter season [Blankenbeckler pers. comm.]. A population estimate was not the major goal of the survey; additional information is required to accurately estimate population size. The importance of this value is its indication that Boca de Quadra is an important rearing habitat for herring.) Envirosphere (1984, p. 4-9) estimates that the loss of 980,000 age-1 herring is equivalent to a net loss of 680,316 age-3 fish. This represents 50,800 kg of herring, 0.9 percent of the average stock biomass for the period between 1978 and 1980, or 9.3 percent of the average Kah Shakes herring roe catch (Envirosphere 1984, p. 4-9). Loss of all age-1 herring is not expected, however, because the population likely moves freely between the inner and middle basin (Blankenbeckler pers. comm.). Displacement

of herring by elevated levels of suspended solids is possible, however, and may cause some reductions in populations because of reduction in available habitat (Section 5). Larval herring, which apparently originate from the Kah Shakes area, are more abundant in the middle basin than the inner basin. Herring spawning areas near Kah Shakes and the outer basin are not expected to be affected by sedimentation.

Shellfish harvests by commercial, sport, and subsistence fishermen in the inner and middle basins could be reduced through mortality and habitat destruction caused by tailings discharge. The zone of most impact is likely to be below 100 m, (330 ft) i.e., where turbidity will be elevated. The magnitude of potential losses cannot be predicted; however, all shrimp species and Tanner crab were most abundant below 100 m (VTN 1980, pp. 105-112). Presently, only spot shrimp and coonstripe shrimp are harvested in the zone below 100 m, but over half of the current harvest occurs within this zone. Although Tanner crab are abundant, most individuals are juveniles and are not harvested. Loss of Tanner crab in the middle basin would not likely affect harvests in the Ketchikan area, although future harvests in the middle basin could be altered.

Although less direct impact would occur to Dungeness crab, harvests could be reduced. Dungeness crab occur to depths of 100 m (330 ft) and are most abundant above 50 m (160 ft) (Envirosphere 1984, p. 4-12). Turbidity and tailings deposition would directly affect those crab below 50 m, with increasingly adverse affects occurring at greater depths. Crab above 50 m would likely restrict their migrational area or experience a reduced food supply at lower depths. Thus, discharge to the inner basin is likely to have greater impact on Dungeness crabs than will middle basin discharge because more of their preferred habitat type will be disturbed. The significance to current harvests is likely to be negligible; the effect on potential harvests is unknown because stock estimates are inadequate for quantification of losses and because it is not known what fraction of the crab population in the inner basin will be lost at any one time.

Harvested species will likely recolonize the inner and middle basins within a few years of project completion. Some mobile species will be able to remain in the inner basin in reduced numbers in areas not undergoing active deposition. Tailings discharged into the inner basin will fill the inner basin to the depth of the sill (110 m [360 ft]) within the first 10 years and thereafter would spill into the middle basin (Section 3). Species that prefer shallow depths, such as Dungeness crab, may be more abundant. Other species that prefer deeper waters, such as shrimps and Tanner crab, would likely be less abundant. It is not known whether and to what extent the rate of colonization of

the tailings deposit by some species (e.g., crabs and shrimp) may be inhibited by the physical or chemical nature of the mill tailings.

<u>Effects on Harvest Quality</u>. Bioaccumulation of heavy metals and tainting of flesh in fish or shellfish captured for human consumption are the factors of most concern in the assessment of harvest quality. Bioaccumulation of metals is discussed in detail in Section 5. Available data suggest that toxic levels of heavy metals will not be taken up by most harvested species. Anderson et al. (1987) reported that only mussels and oysters bioaccumulated trace metals, whereas clams, fish, shrimp and other invertebrates did not. Some increase in heavy metals is possible in herring as they feed on sediment-laden zooplankton during the summer months (Section 5). Because feeding is reduced in winter, herring would likely depurate any body burden attributable to dietary uptake. This bioaccumulation should not be significant. Bivalves, which are likely to be most contaminated of benthic species, are not harvested in Boca de Quadra. Species that are only intermittently exposed to elevated metals concentration should not bioaccumulate metals.

Although tainting of flesh by organic milling reagents, fuel oil, or water soluble hydrocarbons is an unknown, flesh tainting appears to be unlikely because a) few organic compounds that would likely affect harvest quality are present in the tailings discharge, and b) uptake of water soluble hydrocarbons is expected to be limited to small areas around the discharge (Section 5).

<u>Effects of Boca de Quadra Middle Basin Discharges on Harvests</u>

<u>Effects on Harvest Quantity</u>. Discharge to the middle basin would likely affect harvests less than discharge to the inner basin. Less harm to harvest quantities is expected because less area would receive deposited tailings. Approximately 2,050 hectares (5,100 ac) (i.e., the inner and middle basins) would be directly affected by discharge to the inner basin, whereas only 1,600 hectares (4,000 ac) (i.e., the middle basin) would be directly affected by discharges to the middle basin. Some areas in the inner basin may be affected by deposition of suspended solids, but these areas would be substantially less than the 450 hectares (1,100 ac) predicted for inner basin discharge. Furthermore, less harm to potential harvests is expected during middle basin discharge because the inner basin benthic habitat is more productive habitat for commercially exploited species (Section 4).

Discharge to the middle basin would adversely affect deepwater demersal species such as halibut, Tanner crab, and shrimp during the period of discharge to that basin. Relatively

little impact is expected to demersal fish and shellfish species in the inner basin during or after the project. This is in contrast to the adverse effects to both basins when discharging to the inner basin. Tailings discharge to the middle basin may result in approximately 20 percent of the total below-sill volume being filled to a depth of 110-190 m (360-630 ft) (Envirosphere 1984, Appendix G), thereby resulting in addition of up to 400 hectares (1,000 ac) of mid-depth habitat. Because harvestable species are expected to eventually colonize the affected area after cessation of discharge, this change would have minimal impact on the harvest of shrimp or Tanner crab.

A major advantage of middle basin discharge is that the zone of active deposition or mass movement by slumping would never overlap with the pycnocline, thus, middle basin discharge offers less hazard to pelagic species such as herring, salmon, or zooplankton that vertically migrate into the upper water column. Although salmon are not expected to be affected by middle basin discharge, the herring population could be affected during winter when they are deeper (125-150 m) in the water column (Blankenbeckler pers. comm.). A large number of age-1 herring were observed in the inner basin during a winter survey, but it is likely that large schools move from basin to basin (Blankenbeckler pers. comm.). Thus, the major difference in herring abundance in the inner basin and middle basin is probably only the greater abundance of larvae in the middle basin. The larger number of larvae in the middle basin is probably because of its closer location to the spawning grounds.

Effects on Harvest Quality. No difference is expected between the Boca de Quadra discharge options.

Effect of Smeaton Bay Discharge on Harvests

Effects on Harvest Quantity. Most of the effects on harvests noted for Boca de Quadra also pertain to Smeaton Bay. The major differences between the two fjords are that Smeaton Bay supports a significantly larger salmon run and is further removed from the Kah Shakes herring spawning grounds. Larval herring may be less abundant in Smeaton Bay, but juveniles are known to overwinter in the fjord (Blankenbeckler pers. comm.).

The potential for displacement of herring is greater for discharges to Smeaton Bay because tailings deposition and slumping events will occur higher in the water column because the top of the pile will be above the 100 m depth contour toward the end of the project. EPA (1988, Appendix A) modeling of suspended sediments predicts a turbidity plume higher in the water column compared to discharge to the middle basin of Boca de Quadra.

Effects on potential harvests of demersal fish and shellfish are difficult to estimate because of numerous assumptions when extrapolating CPUE estimates in each fjord to biomass estimates. Recognizing the numerous sources of error, EPA (1988, Table 4) has estimated a worst case scenario for loss of economically important species as part of a comparative ecological risk assessment. The scenario estimates approximately 4-5 times as much fish, crab, and shrimp biomass could be lost from discharge to Smeaton Bay compared to discharge to the middle basin of Boca de Quadra.

Potential harvests of demersal fish and shellfish will likely be reduced with a discharge to Wilson Arm because tailings are expected to accumulate on the bottom and be suspended in the water column above the 100 m isobath. Relatively shallow deposits of tailings can alter benthic habitat and effect the food sources for commercial species. The benthic community of Smeaton Bay appears to be more productive per unit area than Boca de Quadra (Appendix B); however, Smeaton Bay is substantially smaller.

The final outcome of discharge to Smeaton Bay would be the conversion of Smeaton Bay from a basin-and-sill fjord system to a shallower, virtually basin-less system similar to that resulting from discharge to the inner basin of Boca de Quadra. Potential harvests after completion of the project could reflect this conversion. Species that prefer shallower habitat (e.g., English sole) may benefit at the expense of deeper species (e.g., Tanner crab, halibut). Assuming that approximately half of Smeaton Bay is now deepwater habitat, tailings discharge would convert approximately 830 hectares (2,000 ac) into mid-depth benthic assemblage habitat.

Effects on Harvest Quality. No difference is expected between Smeaton Bay discharge and either Boca de Quadra discharge.

Section 7

COASTAL ZONE MANAGEMENT AND SPECIAL AQUATIC SITES

Summary

Mill tailings discharge into Smeaton Bay and Boca de Quadra may not be consistent with the following policies of the Alaska Coastal Management Program:

- Mining and mineral processing carried out within the policies established by the program.
- General policy of maintenance or enhancement of affected coastal habitats.
- Maintenance or enhancement of offshore fisheries.
- Maintenance and nondestruction of productive estuarine habitat.

Of the three marine disposal alternatives, discharge to the middle basin of Boca de Quadra is at least risk of violating ACMP policies.

Article 3 of the ACMP provides for possible approval of a nonconforming use if there is a significant public need, if there are no feasible and prudent alternatives that conform to ACMP policies, and if all feasible and prudent steps are taken to maximize conformance. If the project can be shown to satisfy these three requirements, then the project may be deemed in agreement with the policies of the ACMP.

Coastal Zone Management

Requirements of the Coastal Zone Management Act

The Coastal Zone Management Act requires that states make consistency determinations for any federally licensed or permitted activity affecting the coastal zone of a state with an approved Coastal Zone Management Program (CZMP) (16 USC Sec. 1456[c][A] Subpart D). Under the Act, applicants for federal licenses and permits must submit a certification that the proposed activity complies with the state's approved CZMP. The state then has the responsibility to either concur with or object

to the consistency determination. Under Section 403c guidelines, the State of Alaska shall determine whether the applicable requirements of an approved CZMP have been met.

Status of Coastal Zone Management Planning

The Alaska Coastal Management Program (ACMP) was approved by the U. S. Department of Commerce in 1979. The state coastal management policies and guidelines included in the ACMP are intended to be refined by local districts preparing district Coastal Management Plans (CMPs). In areas where a local district plan has not been developed and approved by local, state, and federal governments, the consistency assessment is based on the policies of the approved ACMP. The Quartz Hill Mine project area is not within the boundaries of a local district CMP; therefore, disposal of mill tailings must be evaluated under the ACMP.

Relevant Policies of the Alaska Coastal Management Program

Policies of the ACMP that are potentially relevant to mill tailing discharges from the Quartz Hill project are set forth in the ACMP standards (6 AAC Chapter 80). Land-based uses and activities are restricted by the management objectives of the Misty Fjord National Monument and are not evaluated as part of this ODCE.

Article 2 of the ACMP sets forth standards related to coastal development, geophysical hazard areas, recreation, energy facilities, transportation and utilities, fish and seafood processing, timber harvest and processing, mining and mineral processing, and subsistence. Of these coastal zone uses and activities, recreation, mining and mineral processing, and subsistence potentially occur in the area of proposed discharge.

The ACMP policy for recreation includes designation of areas for recreational use. Criteria for designation include an existing significant use and/or major tourist destination and potential for a high quality recreational use. Priority also is given to maintaining and improving public access to coastal waters. Alaska has not designated Boca de Quadra or Smeaton Bay as recreational areas (Mills pers. comm.).

Mining and mineral processing policy requires that such activities be consistent with other policies established by the ACMP.

Policy toward subsistence uses includes recognizing and assuring opportunities for subsistence uses, identifying areas of significant subsistence use, and establishing priority use zones. Although some subsistence use occurs, Boca de Quadra and Smeaton Bay have not been identified as significant subsistence use areas (Mills pers. comm.).

Article 3 of the ACMP sets forth standards for resources and habitats that are relevant to tailings disposal in Boca de Quadra. Of the habitat types it identifies, offshore areas, estuaries, and wetlands and tideflats could be affected by this discharge. The fundamental standard for management of these habitats is that they "must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130[b]).

In addition, the following standards apply to these specific habitats:

- o "Offshore areas must be managed as a fisheries conservation zone so as to maintain or enhance the state's sport, commercial, and subsistence fishery" (6 AAC 80.130[c][1]).

- o "Estuaries must be managed so as to assure adequate water flow, natural circulation patterns, nutrients, and oxygen levels, and avoid the discharge of toxic wastes, silt, and destruction of productive habitat" (6 AAC 80.130[c][2]).

- o "Wetlands and tideflats must be managed so as to assure adequate water flow, nutrients, and oxygen levels and avoid adverse effects on natural drainage patterns, the destruction of important habitat, and the discharge of toxic substances" (6 AAC 80.130[c][3]).

<u>Consistency of Tailings Disposal with Relevant Alaska Coastal Management Program Policies</u>

The discharge of mill tailings into Smeaton Bay or the inner or middle basin of Boca de Quadra may not be consistent with all relevant policies of the ACMP. A discussion of each policy and its assessment is presented below.

<u>Recreation</u>. Discharge to either fjord appears to be consistent with ACMP policy on recreation because the policy is applicable to areas designated as areas of significant use and neither fjord has been designated such an area. Recreational use of Boca de Quadra or Smeaton Bay may be adversely affected by decreased fishery resources but enhanced by improved access to the area.

<u>Mining and Mineral Processing</u>. The discharge may be inconsistent with ACMP policy on mining and mineral processing because of potential conflicts with other policies established by the ACMP relative to productivity of coastal habitat, offshore areas, estuaries, wetlands, and tideflats.

Subsistence. Because Smeaton Bay and Boca de Quadra have not been designated significant subsistence use areas, the proposed discharge may be consistent with this policy. The low level of subsistence harvesting that may occur in the two fjords may be reduced or cease, but the use is limited in scope.

Coastal Habitat. The proposed discharge appears to be inconsistent with ACMP policy on coastal habitat in general. The proposed discharge will not maintain or enhance the biological, physical, and chemical characteristics of Smeaton Bay or the inner and middle basin habitats of Boca de Quadra. These habitats will have a reduced capacity to support living resources for at least the life of the project. Following completion of the mining operations, stabilization of the tailings deposits, and deposition of natural sediments on the surface, it is possible that benthic productivity would be enhanced over the long term because shoaling tends to result in higher benthic productivity. However, this potential enhancement is unpredictable in nature and magnitude and will not be realized until several decades after the project has begun.

Offshore Areas. The proposed discharge will occur in fjords known to be occupied by overwintering herring. Discharge to Smeaton Bay and the inner basin of Boca de Quadra will place deposited tailings and elevated suspended solids concentration within the known depth range of overwintering herring. These herring stocks support a major commercial fishery at the mouth of Boca de Quadra (Section 6). It is not known whether overwintering herring will be displaced and, if so, whether this will affect the spawning stock in the project area. Thus, the proposed discharge may not maintain or enhance the state's sport, commercial, and subsistence fishery for at least the life of the project. Discharge to the middle basin of Boca de Quadra will have the least impact on overwintering herring habitat; thus, discharge to the middle basin may be the most consistent with ACMP policy relevant to offshore areas.

Estuaries. Discharge to Smeaton Bay or the inner basin of Boca de Quadra may be inconsistent with ACMP policy relevant to estuaries. For the purpose of this ODCE, estuarine habitat is defined to include the shallow water habitat shoreward of the toe of the alluvial deposit formed at the head of Boca de Quadra and Wilson Arm by the Keta and Wilson Rivers, respectively. The proposed discharge will alter the balance of forces which drive circulation patterns in Smeaton Bay and in the upper reaches of Boca de Quadra. It is not clear what effect this may have on the Wilson River/Blossom River estuary and the Keta River estuary. The proposed discharge to the middle basin of Boca de Quadra is not likely to significantly alter circulation patterns of Boca de Quadra because the discharge of mill tailings is not expected to

significantly alter the basin-and-sill configuration of the fjord. Thus, discharge to the middle basin of Boca de Quadra may be consistent with ACMP policy relevant to estuaries.

The discharge of mill tailings can be considered a discharge of silt material. Discharge of mill tailings to the inner basin of Boca de Quadra could result in siltation and turbidity impacts in the Keta River estuary if turbidity plumes reach the epipelagic zone during weak water column stratification or if resuspension becomes a problem when the inner basin is filled. Similar concerns for the Wilson River estuary exist for discharge via outfall in Wilson Arm. The discharge of silt to estuaries is not consistent with ACMP policy if acceptable alternatives are available. The discharge of mill tailings to the middle basin of Boca de Quadra is not likely to result in upper water column turbidity that could affect the Keta River estuary.

Wetland and Tideflats. The proposed discharge is consistent with ACMP policy on wetland and tideflat habitat. Impacts from the proposed discharge are predicted to be contained below the pycnocline. Suspended solids concentrations in the upper water column should be too low to result in measurable deposition of fines in wetland or tideflat areas.

Criteria for Approving Nonconforming Use

Article 3 of the ACMP provides for the consideration and possible approval of a nonconforming use or activity if the following three requirements are met:

- there is a significant public need for the proposed use or activity;
- there is no feasible, prudent alternative to meet the public need for the proposed use or activity which would conform to the ACMP policies; and
- all feasible and prudent steps to maximize conformance with the ACMP policies will be taken.

The DEIS (Envirosphere 1984) does not describe the need for the mine project. U.S. Borax has submitted a brief Statement of Need as an attachment to its permit application package submitted to EPA on 25 April 1984.

If the state determines that public need is identified, then other disposal options must be evaluated for feasibility and prudence. Land disposal options have been addressed in the DEIS. Land disposal alternatives are feasible but may be judged imprudent when other environmental costs and economic factors are considered.

Article 3 also requires that other state requirements for the protection of air, land, and water quality be met. Compliance with state water quality standards is appropriate and addressed in Section 8.

Special Aquatic Sites

No designated marine sanctuaries or other aquatic sites within the meaning of 40 CFR 125.122(a)(5) are located within Smeaton Bay or Boca de Quadra. The boundaries of the Misty Fjord National Monument extend only to the high tide elevation (Barber pers. comm.) and thus do not include the marine environment below this tidal elevation.

Section 8

MARINE WATER QUALITY CRITERIA

Summary

The discharge of mill tailings is unusual because minimum dilution and dispersion is probably desired in order to rapidly transport tailings to below-sill depth. Established methods of designating a mixing zone, which generally provides for maximum dilution, may not apply.

Stochastic modeling indicates that suspended solids would exceed water quality standards over a large part of either fjord. Suspended solids would reach higher in the water column during discharges to the middle basin of Boca de Quadra (up to the 20 m isobath) than during discharges to Wilson Arm (up to 60 m). Discharges to Wilson Arm will cause suspended solids to enter Behm Canal. Tailings should be confined to Boca de Quadra during discharge to the middle basin, although an increase in suspended solids could impact adjacent areas of the inner and outer basins of Boca de Quadra. Discharge to the inner basin would likely cause increased suspended solids in the upper water column (100 m) of both the middle and inner basins.

Water quality degradation (exceedance of the water quality criterion for copper measured as extractable portion of the suspended solids) is predicted to occur throughout the water column as a result of tailings discharge in either of the two fjords proposed as alternative disposal sites.

Leaching of dissolved metals is not expected to increase significantly in neutral or basic pH environments. Leaching of dissolved metals may occur in acidic environments such as anaerobic sediments, most fish stomachs, and some invertebrate stomachs.

Dissolved oxygen depletion is not expected to occur with tailings discharge. Entrainment of near-surface water in the discharge will provide sufficient oxygen to meet maximum BOD_5 loading.

Discharge of treated wastewater from the marine terminal to Wilson Arm is not expected to violate water quality standards beyond a 100 m mixing zone for most constituents. It is not known whether concentrations of chlorine or dissolved hydrocarbons will meet state standards because concentrations in the effluent are not known.

Introduction

State of Alaska water quality standards have been established to protect beneficial uses of marine waters. The standards specify concentrations of various water quality parameters that cannot be exceeded. To comply with Alaska water quality standards, the discharge must comply with EPA water qualtiy criteria or Alaska drinking water standards, whichever are lower, at the edge of a designated mixing zone. The applicable Alaska water quality standards for discharge of mill tailings and wastewater to Boca de Quadra or Smeaton Bay are listed in Table 8-1.

Mixing Zone

The concept of a mixing zone for a marine discharge is based on the premise that most discharges are buoyant and are subsequently diluted and dispersed with distance from the source. Usually the major objective is to dilute and disperse the effluent as quickly as possible so as to minimize the adverse effect on water quality. In determining the size of mixing zones, the state of Alaska (18 AAC 70) will consider the following:

- the physical, biological, and chemical characteristics of the receiving water;
- the effects of the discharge on present and anticipated protected water uses and quality of the receiving water;
- the mixing characteristics of the receiving water; and
- the characteristics of the effluent, including flow rate and composition.

Minimization of the impact caused by the Quartz Hill tailings discharge does not readily fit the mixing zone concept of rapid dispersion and dilution. Rapid dilution of dissolved metals and dissolved ore processing reagents in the effluent is desirable, but confinement of the tailings to a local area is considered the best strategy for solids deposition and probably suspended solids. Minimum impact from suspended solids and subsequent deposition on the seafloor could be achieved if the effluent density is regulated so as to create a relatively cohesive density current flowing to the bottom of the fjord out of the zone of greatest biological value (i.e., the upper 100 m of benthic and pelagic habitat) (Section 4). Thus, a tradeoff exists between dilution of potential effluent toxicants and confinement of suspended and deposited solids.

Table 8-1. Alaska Water Quality Standards (18 AAC 70) at the Edge of Designated Mixing Zones.

PARAMETER	STANDARDS FOR CLASS 2 WATER (MARINE)[a]
Dissolved oxygen	$\geq$6.0 mg/l for upper 1 m, but $\geq$5.0 mg/l at other depths; $\leq$17.0 mg/l except for natural causes.
pH	$\leq$0.1 deviation from natural but not <6.5 or >8.5 from man-caused sources.
Turbidity	$\leq$25 NTU; $\leq$10 percent reduction in Secchi depth or compensation point.
Temperature	$\leq 1^{o}C$ weekly average temperature increase, change $\leq 0.5^{o}C$ per hour from natural.
Dissolved inorganic substances (salinity)	$\pm$10 percent change of natural isohaline pattern.
Suspended solids	No measurable increase above natural conditions.
Sediment	No measurable increase above natural conditions.
Residues	No deposition of a sludge, solid, or emulsion on the bottom, beneath or upon the surface of the water, in the water column, or upon the adjoining shoreline. No film, sheen, or discoloration on the surface of the water or shoreline.
Toxic & other deleterious organic & inorganic substances	$\leq$0.01 times lowest 96-hr LC50, Quality Criteria for Water (U. S. EPA), or Alaska Drinking Water Standards (18 AAC 80), whichever is lowest.
Color	15 color units or <10 percent reduction in compensation point.
Petroleum hydrocarbons, oil and grease	$\leq$10 ug/l total aromatic hydrocarbons, $\leq$15 ug/l total hydrocarbons, or $\leq$0.01 times 96-hr LC50 (see code for details); no visible sheen for oil and grease; shall not taint organisms.
Radioactivity	Shall not exceed the concentrations specified in the Alaska Drinking Water Standards or limits established in Code of Federal Regulations.
Fecal Coliform Bacteria	MPN <14 FC/100 ml, <10 percent of samples >43 FC/100 ml.

[a] Alaska varies standards by designated uses of the water body. Since Boca de Quadra and Smeaton Bay are specified as suitable for all uses, the most restrictive value for each parameter was used.

The mixing zone is defined as the volume of water contiguous to some discharge for which the receiving waters may not meet all the criteria for water quality. In the case of the discharge of tailings from the Quartz Hill project, suspended solids and toxicity due to heavy metals are two criteria which should be considered. A three-dimensional, steady-state model describing the processes of advection, diffusion and settling of solids was used by EPA to estimate the approximate dimensions of the mixing zone in the fjord chosen for tailings disposal. The model incorporated environmental variability into the estimate. The dimensions of the mixing zone were then characterized in terms of the probability that a given level would be exceeded.

For suspended solids, the volume was estimated by finding the region within which the estimated levels had a 5 percent probability of being greater than 5.0 mg/l. In Boca de Quadra, the boundaries estimated in this way included the entire width of the fjord from the distal end to at least two kilometers seaward of the Kite Island sill and to within 20 meters of the fjord surface at project year 55. For Smeaton Bay/Wilson Arm, the estimated boundaries comprise the width of the fjord from the distal end of Wilson Arm to at least four kilometers into Behm Canal and within 60 meters of the surface at project year 55.

For toxicity due to heavy metals, the criterion was based upon the concentrations of total recoverable copper estimated from the suspended solids levels. The mixing zone dimensions were estimated by determining which volumes had an estimated concentration of total recoverable copper of 2.9 ug/l more than 5 percent of the time. The dimensions of the mixing zone in project year 55 for Boca de Quadra, determined in this way, include the entire width of the fjord in the inner basin for depths greater than 120 meters and in the middle basin for depths greater than 160 meters. In addition, there is a two kilometer long region over the sill between middle and inner basins for which the mixing zone for copper toxicity extends to within 100 meters of the surface. The mixing zone in project year 55 in Smeaton Bay/Wilson Arm comprises approximately 55 percent of the width of the fjord in the first kilometer and 10 percent of the width in the second kilometer between 60 and 80 meters depth . Between 80 and 100 meters, the estimated boundaries include the entire width up to five kilometers from the distal end of the fjord and 10 to 35 percent of the width for the next five kilometers. From a depth of 100 meters to the bottom, the mixing zone includes the entire fjord. In addition, a lens of tailings located below 100 meters of water depth will extend into Behm Canal. This lens will be 30 meters deep for the first kilometer and reduce to 10 meters deep for an additional 2 kilometers.

The difference in the nature of the mixing zone volumes for suspended sediments and copper toxicity between Smeaton Bay/Wilson Arm and Boca de Quadra is due primarily to the difference in the depth of effective discharge and to the oceanographic processes in each of the fjords. In Boca de Quadra the effective depth of discharge is greater, but the stability of the water column is less than in Smeaton Bay/Wilson Arm. The net result is that the suspended solids are diffused higher into the water column in Boca de Quadra than in Smeaton Bay/Wilson Arm even though the effective discharge point in Smeaton Bay is shallower than that in Boca de Quadra. In Smeaton Bay/Wilson Arm there is less vertical diffusion, which confines the tailings plume to depths below 60 meters, but also results in higher concentrations. The overall effect is for a wide distribution of suspended solids within Boca de Quadra for which the estimated copper toxicity is low at depths less than 100 meters. In Smeaton Bay/Wilson Arm the plume is confined to a relatively long, thin layer for which the concentrations of suspended solids and estimated total recoverable copper is high. Since the effective discharge point for Smeaton Bay is within 75 meters of the surface in project year 55, this results in a greater level of estimated copper toxicity in Smeaton Bay/Wilson Arm above 100 meters depth than in Boca de Quadra.

Suspended Solids and Sedimentation

Discharges of mill tailings at any of the proposed locations would exceed the state criterion of no measurable increase (Table 8-1) of suspended solids in large portions of either fjord. EPA's modeling indicates suspended solids concentration over the sills would reach 4-14 mg/l (inner basin sill), 20-42 mg/l (Kite Island sill), or 32-54 mg/l (Smeaton Bay sill) for either middle basin or Smeaton Bay discharges, respectively (EPA 1988, Appendix A, Figures 10 and 11). Increased suspended solids would likely penetrate higher in the water column during discharges to the middle basin (up to 20 m depth) than during discharges to Smeaton Bay (up to 60 m). Discharges to the inner basin would probably also reach relatively high in the water column because the top of the tailings pile in the inner basin would be at depths comparable to the pile in Wilson Arm. Impacts related to suspended solids are discussed in Section 5.

Sedimentation of habitats deeper than 50 m would likely occur throughout Smeaton Bay, whereas sedimentation in the middle basin of Boca de Quadra would likely occur at depths greater than 20 m. Although some sedimentation could occur in the deeper areas of the inner basin as a result of middle basin discharge, most sedimentation should be confined to the middle basin. Discharge to the inner basin would cause extensive sediment deposition in both the inner and middle basins.

Metals Concentration

Total Recoverable Metals

The metal content of the ore body and tailings is given in Table 8-2. Two chemical fractions which remain after the ore is processed to form tailings were selected for this evaluation: 1) the dissolved fraction, and 2) the particulate extractable fraction. The dissolved metal fraction results from leaching during the mixing of ore particles with process water and seawater. The particulate metal fraction is that portion of the metal which is bound to the particulate matter. Both fractions are important in assessing the risks from metal toxicity. Total recoverable metals according to EPA protocol includes both the dissolved and the extractable fraction of the metals.

Of the metals identified in the ore and tailings, silver, copper, and mercury are the most toxic metals. Based on the measurements of the tailings material, silver, copper, and lead were found in the highest concentrations. Since copper was considered one of the most toxic as well as being found in the highest concentration, it was selected as representative of all metals.

The quantitative estimate of the mixing zone discussed above is based on the distribution of suspended solids and the copper portions (dissolved and extractable).

In order to characterize the distribution of copper in the water column, the concentration of each component of the tailings must be determined by chemical analytical measurement or theoretical predictions. During the milling process ore is ground and mixed with water and reagents. The tailings which are finally released into the water column are made up of ground ore (metallic elements), dissolved elements (reagents and metals), and seawater.

The various forms of copper which are important to consider in evaluating water column impacts are provided in Table 8-2. The dissolved copper concentration was measured in several laboratory tests, and reported in the RDEIS. The solid phase (ore and tailings) copper characterization was presented in Appendix A of the RDEIS. For purposes of evaluating the potential release of copper toxicity, the total recoverable fraction must also be analyzed. The total recoverable fraction accounts for both the dissolved and acid extractable portions of copper. U.S. Borax did not measure the total recoverable metal fraction according to EPA protocols. However, an alternate method specified as an "extractable" tailings

Table 8-2. Mill tailings solid and liquid phase metal composition. Samples are from the proposed Quartz Hill mining area. EPA 1986 Water Quality Criteria are included for comparison with the dissolved and extractable liquid phase concentrations.

	SOLID		EXTRACTABLE			DISSOLVED		EPA WATER QUALITY
	Ore[a] (mg/kg)	Tailings[b] (mg/kg)	Tailings (c) (mg/kg)	Tailings (d) (mg/kg)	Tailings (e) (mg/kg)	Effluent[f] (ug/l)	Tailings Discharge[g] (ug/l)	Chronic Criteria [h] (ug/l)
Antimony		0.002						
Arsenic		10.9	4.8			6.8	3.2	36.0
Cadmium		2.4	0.6			15.0	5.05	9.3
Chromium		10.0	4.4			34.0	11.43	50.0
Cobalt		3.3						
Copper	90	69.0	22.0	40.0	90.0	35.0	11.87	2.9
Iron	16900		8704.0	7436.0	16900.0	1790.0	0.2 [i]	
Lead	60	47.0	10.0	26.0	60.0	120.0	40.0	5.6
Manganese		462.0	106.0			330.0	550. [i]	
Mercury		0.05	0.022			1.2	0.4	0.025
Molybdenum	2170	120.0	120.0	955.0	2170.0	1080.0	500. [i]	
Nickel		17.7	7.8			290.0	96.9	7.9
Selenium		0.1	0.044			6.6	2.27	54.0
Silver		0.13	0.057			7.0	2.3	2.3
Vanadium		17.6						
Zinc	40	46.0	23.0	18.0	46.0	77.0	26.0	86.0

(a) U.S. Forest Service RDEIS, Appendix E.
(b) U.S. Borax 1984b
(c) U.S. Forest Service RDEIS, Appendix F.
(d) U.S. Forest Service RDEIS, Appendix E, based on Burrell's (1983) assumption that on the average 44 percent of the solid metals are extractable.
(e) Appendix E, RDEIS assuming 100 percent of ore content is extractable.
(f) Effluent concentration; U.S. Forest Service, RDEIS, Appendix F, Table F-2.
(g) Discharge concentration; U.S. Forest Service, RDEIS, Appendix F, Table F-2.
(h) 96 hour average concentration not to be exceeded more than once every three years on the average. Refers to measurements of total recoverable metals.
(i) U.S. Forest Service RDEIS, Appendix F, Table F-2. Footnote.

characterization was presented in the RDEIS Appendix F, Table F-6. The "extractable" portion of tailings may be converted to a water column concentration by the following equation:

$$(1)\qquad \begin{array}{c}\text{Tailings}\\ \text{Metal Extractable}\\ \text{Portion}\\ (\text{mg/mg})\end{array} \times \begin{array}{c}\text{Water Column}\\ \text{Suspended Solid}\\ \text{Concentration}\\ (\text{mg/l})\end{array} = \begin{array}{c}\text{Water Column}\\ \text{Metal Extractable}\\ \text{Concentration}\\ (\text{mg/l})\end{array}$$

According to the description of extractable metal presented in Appendix E, RDEIS, 100 percent of the copper content (90 ug/g) of the ore and 44 percent (40 ug/g) of the copper content of the ore were selected as representative of the range of maximum copper concentrations which may be experienced during the life of the mine. While these copper concentrations may not be accurate, they represent in the first case the actual measured maximum copper content of the ore (total copper) and in the second case an estimate of the average extractable portion of total ore for all metal fractions (reported in RDEIS, Appendix F, from Burrell 1983). These estimates of copper content were used only for comparison with the water quality criterion and are not necessarily the true concentration of extractable copper which may only be obtained by chemical analysis of tailings (solid and water) using the EPA prescribed total recoverable method.

Copper water quality criterion will be exceeded in both fjords in the deeper water (greater than 100 meters), during all years of the proposed project (EPA 1988, Tables 7a, 7b, 7c, and 7d). The likelihood of exceedance of the criterion increases with increasing extractable copper (from 44 percent to 100 percent) and as the project proceeds to year 55. The probability of exceeding the criterion increases in the upper water column Smeaton Bay/Wilson Arm as the project proceeds to year 55. This is not true for Boca de Quadra. The prediction of lower concentration of suspended solids in the upper water column in middle basin results in a decrease in the concomitant copper concentration.

The estimates of extractable copper used to compute the probability of violating the water quality criterion are based on worst case assumptions of copper leaching (ranging from 100 percent to 44 percent of the ore). All estimates of extractable copper presented in the RDEIS (Appendix E, Appendix F) were compared to the worst case estimate (EPA 1988, Table 8).

For Smeaton Bay/Wilson Arm, the extractable concentration will exceed the water quality criterion (2.9 ug/l) for all cases except the lowest measurement of extractable copper (EPA 1988, Table 8). In Boca de Quadra, the criterion will only be exceeded for the maximum predictions of extractable copper (100 percent of ore; 100 percent of tailings).

Metal Leaching from Sediments

Laboratory experiments on bioaccumulation of metals in seawater have indicated some leaching of molybdenum and manganese from the tailings (E.V.S. Consultants 1984b, p. 30). Other metals did not leach into the water column during the laboratory test. Under slightly acidic conditions, such as in fish stomachs, Goyette and Christie (1982, p. 35) observed leaching of copper and lead from Kitsault Mine tailings. Leaching, however, does not appear to be a major contributor of dissolved metals to the receiving water. Studies (Pedersen, unpublished report) on the distribution of iron, manganese, molybdenum, and copper in interstitial waters collected from mine tailings and natural sediments in Rupert and Holberg Inlets, British Columbia (Island Copper Mine), show that the leaching (flux) of metals from deposited tailings is likely a minor contributor to the total dissolved metals in the receiving waters. Heavy metal enrichment of the water column is more likely the result of the tailings being discharged, undergoing mass movement (e.g., slumping), or being resuspended.

Thus, elevated levels of manganese and molybdenum may occur in the water column as a result of leaching. Burrell (1983, Figures 7.II.7, 7.III.12, and 7.IV.11) noted sediment concentrations of manganese on the order of 100-160, 15-3,385, and 40-95 ug/g in the inner basin of Boca de Quadra, middle basin of Boca de Quadra, and Smeaton Bay, respectively. Tailings solids are expected to have 462 mg/kg (ug/g) manganese (Table 2-3). Thus, manganese levels in tailings are within the range of natural sediments in the middle basin, but higher than Smeaton Bay or the inner basin of Boca de Quadra. Molybdenum is likely to occur in the biologically inactive sulfide form (Burrell 1983, p. 28), thus, leaching of molybdenum is not likely to affect biota.

Redox processes in benthic sediments may affect the release of dissolved metals into the water column. Metal ions from the overlying water or upward migrating pore solutions in the sediments may be sorbed or coprecipitated onto manganese- and iron-oxide layers near the sediment surface (Forstner and Wittman 1979, pp. 252-255). Release of these dissolved metals into interstitial water would occur during the reduction of the oxide compounds caused primarily by low oxygen concentration and to a lesser extent by low pH. Sulfide produced by bacterial activity would reduce the mobility of dissolved metals, although this mechanism is debatable (Forstner and Wittman 1979, p. 252). Factors including turbulent exchange, release of gases from microbial activity, movement of benthic organisms, and molecular diffusion may then introduce the dissolved metals back into the overlying water column. The extent to which the redox processes would occur in either fjord is unknown, although the greatest release of dissolved metals

would likely occur after the project ends. After the project, oxygen transport from the surface to deep waters via tailings discharge would cease, causing a decrease in redox potential and possibly the liberation of some dissolved metals from the sediments.

Dissolved Oxygen

Concentrations of milling chemicals in the effluent, which may result in BOD or COD, are not well characterized and may be more variable in concentration than dissolved metals. Chemical analysis of pilot plant effluent by gas chromatography/mass spectroscopy has not shown significant concentrations of organic compounds; E.V.S. Consultants (1984a) found one long-chain alcohol compound at concentrations between 50-100 ul/l. Additional analyses performed by Lauck's Testing Laboratories for U.S. Borax found concentrations of the milling reagent MIBC (methyl isobutyl carbonol) at 16.8 mg/l (Cronin pers. comm.). The only other organic compound noted was an oxidation product of MIBC. One reason for these findings is that breakdown products have never been identified for these reagents. Also, standards of the reagents were not assessed for comparison with the effluent results. In short, neither the identification of the reagents nor the applicability of the method to analyze for the reagents have been demonstrated. Detailed descriptions of sample handling, sample preparation and work-up, analytical methods, and quality assurance/quality control are not available. In summary, actual amounts of organics discharged are not known.

Oxygen depression can be calculated for the effluent based on a maximum BOD_5 of 30 mg/l (Table 2-1) for the predilution effluent volume of 30.7 mgd (1.2×10^8 liters/d) (Section 2). After dilution in the mixing chamber, the total discharge would increase to 92.1 mgd (3.49×10^8 liters/d) and the BOD value would be reduced from 30 mg/l to 10 mg/l, assuming no BOD caused by the additions of seawater. The effluent is expected to be diluted further by a ratio of 10:1 at 100 m from the discharge source (Section 3), resulting in a BOD of 0.91 mg/l transported to below-sill depths. With a total below-sill transport of 3.83×10^9 liters/day (effluent and entrained seawater), this represents a BOD loading of 3.49×10^6 g O_2/d to below-sill depths. However, the effluent would entrain oxygen from the surface layer (| 5.0 mg/l) and would transport approximately 1.86×10^7g $O_2/\overline{d}$ to the below-sill region. Thus, approximately 19 percent of the total oxygen in the entrained dilution water would be consumed by BOD_5, resulting in a net input concentration of 4.1 mg O_2/l. Thus, an oxygen gain rather than decrease would result from the effluent discharge, assuming an oxygen concentration as low as 3 mg/l in the below-sill region of either fjord (Table 3-1).

A potential flaw in this analysis is that the reported maximum BOD_5 (U.S. Borax 1985) is based on tests of a decanted tailings slurry (Cronin, pers. comm.). Rescan Environmental Services (1984, p. 44) estimates that half of the discharged milling reagents will be adsorbed to the solids. In Table 2-5, the major organic reagent suspected for loading is M-502, a flocculant. Carlson (pers. comm.) assumes that at least 80 percent of this reagent will be adsorbed to the solids. Thus, it is possible that the reported BOD_5 of 30 mg/l does not include most of the organic milling reagent because they were adsorbed to solids which were not decanted and tested. On the other hand, M-502 is reported to be biostatic, i.e., have little BOD_5 (Hart pers. comm.); therefore the reported BOD_5 may be an acceptable worst-case estimate. SF330, an alternative quaternary ammonium compound (Table 2-4), has a BOD_5 of 100 mg/g. Assuming that M-502 had a comparable BOD_5, a reagent loading of 7,200 kg/d (Table 2-5) would result in an effluent BOD_5 contribution of 7.2×10^5 g/d, or 6.2 mg/l. This further indicates that 30 mg/l is a conservative BOD_5 estimate for the tailings effluent prior to predilution and that dissolved oxygen depression is of little concern for discharge to either fjord.

Marine Terminal Wastewater Outfall Effluent

Major constituents of the wastewater discharge in Smeaton Bay at their maximum reported concentrations include suspended solids (45 mg/l), ammonia (15 mg/l), BOD_5 (45 mg/l), chlorine water soluble petroleum hydrocarbons, and oil and grease (15 mg/l). Of the constituents with estimated maximum loading values (U.S. Borax 1985), suspended solids will require the greatest dilution (45:1) to meet the state water quality standards. No saltwater criteria for ammonia have been established by EPA, although 4-day average criteria of 0.82-2.4 mg/l have been established for salmonids in 5°C freshwater at pH 7.5-8.5. To achieve a total ammonia concentration of 0.82 mg/l, a dilution of 18:1 would be necessary.

A dilution of 45:1 should be easily achieved in Wilson Arm. Assuming an outfall depth of 6 m (20 ft) and a freshwater plume occupying 10 percent of the mixing zone (radius 100 m [330 ft]), the plume will occupy a volume of 19,000 m^3 (5 million gallons). Effluent discharges are expected to be 39,000 gal/d. Thus, the volume of water in 10 percent of the mixing zone that is available to dilute a full daily discharge results in a dilution of 128:1. Actual dilution will be much greater because of current-mediated dispersion of the plume and replenishment of seawater in the mixing zone during the course of the day.

It is not known whether concentrations of chlorine or dissolved hydrocarbons will meet state water quality standards because concentrations in the effluent are not known. Dechlorination would eliminate concern about chlorine toxicity to salmonids.

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APPENDICES

Appendix A

PLANKTON RESOURCES

Introduction

The plankton is composed of small organisms that are carried about primarily by water currents rather than by their own swimming activity. Plankton may spend all (holoplankton) or part (meroplankton) of their life cycle in the water column. Phytoplankton are photosynthetic organisms frequently limited to shallow surface waters by light availability. As primary producers, they are the base of epipelagic food webs and contribute significantly to food webs of nearshore and estuarine habitats. Phytoplankton are consumed by herbivorous zooplankton and larval fish (ichthyoplankton). Zooplankton inhabit the upper few hundred meters of the water column and are herbivorous, carnivorous, or omnivorous. They are ecologically important in that they affect phytoplankton population growth, recycle nutrients, and/or are prey for other zooplankters, fish, or whale species. The success of the zooplankton in translating energy from the primary producers into secondary production is thought to directly affect the success of fish cohorts.

Biological and hydrographic/chemical data were collected during 1978-83 in Boca de Quadra and 1981-82 in Smeaton Bay. Biological data included measures of phytoplankton cell density, chlorophyll a concentrations, C^{14} uptake, zooplankton and ichthyoplankton densities and ash free dry weight. Hydrographic/chemical data included redox potential, water clarity, conductivity, salinity, temperature as a function of depth, and measures of light, nutrient, and dissolved oxygen levels (VTN 1980, pp. 15-22; VTN 1981b, pp. 13-19).

Phytoplankton Resources

The major phytoplankton groups within Boca de Quadra and Smeaton Bay fjords included diatoms, dinoflagellates, and microflagellates (Table A-1). The diatoms and larger dinoflagellates comprise the net- and nannoplankton fractions (>5 um) and the microflagellates comprise the ultraplankton fraction (<5 um). Of these three groups, diatoms and microflagellates were dominant in terms of number of taxa and productivity. Seasonal patterns of abundance (cells/cm^3) and productivity (mg C/m^3/hr) of these groups were generally similar to those documented for temperate estuaries and fjords (VTN 1980, p. 45). Peak cell densities and productivity occurred during spring between March and May. Diatoms were the principal agents

Table A-1. Key Phytoplankton Species in Boca de Quadra and Smeaton Bay

BACILLARIOPHYTA (diatoms)

Skeletonema costatum
Chaetoceros spp.
Thalassiosira nordenskioldii
Bacteriastrum delicatulum
Leptocylindrus spp.

PYRROPHYTA (dinoflagellates)

Gymnodinium spp.

CRYPTOPHYTA (microflagellates)

Cryptomonas spp.
Hemiselmis spp.

PRASINOPHYTA (microflagellates)

Pyramimonas sp.
Tetraselmis sp.

EUGLENOPHYTA (euglenoid flagellates)

Eutreptia sp.

OTHER MICROFLAGELLATES

Unidentified species

Note: This list is a compilation of key species lists for the two fjords. Although all species on this list were present in both fjords, there were differences between the fjords in their relative abundance.

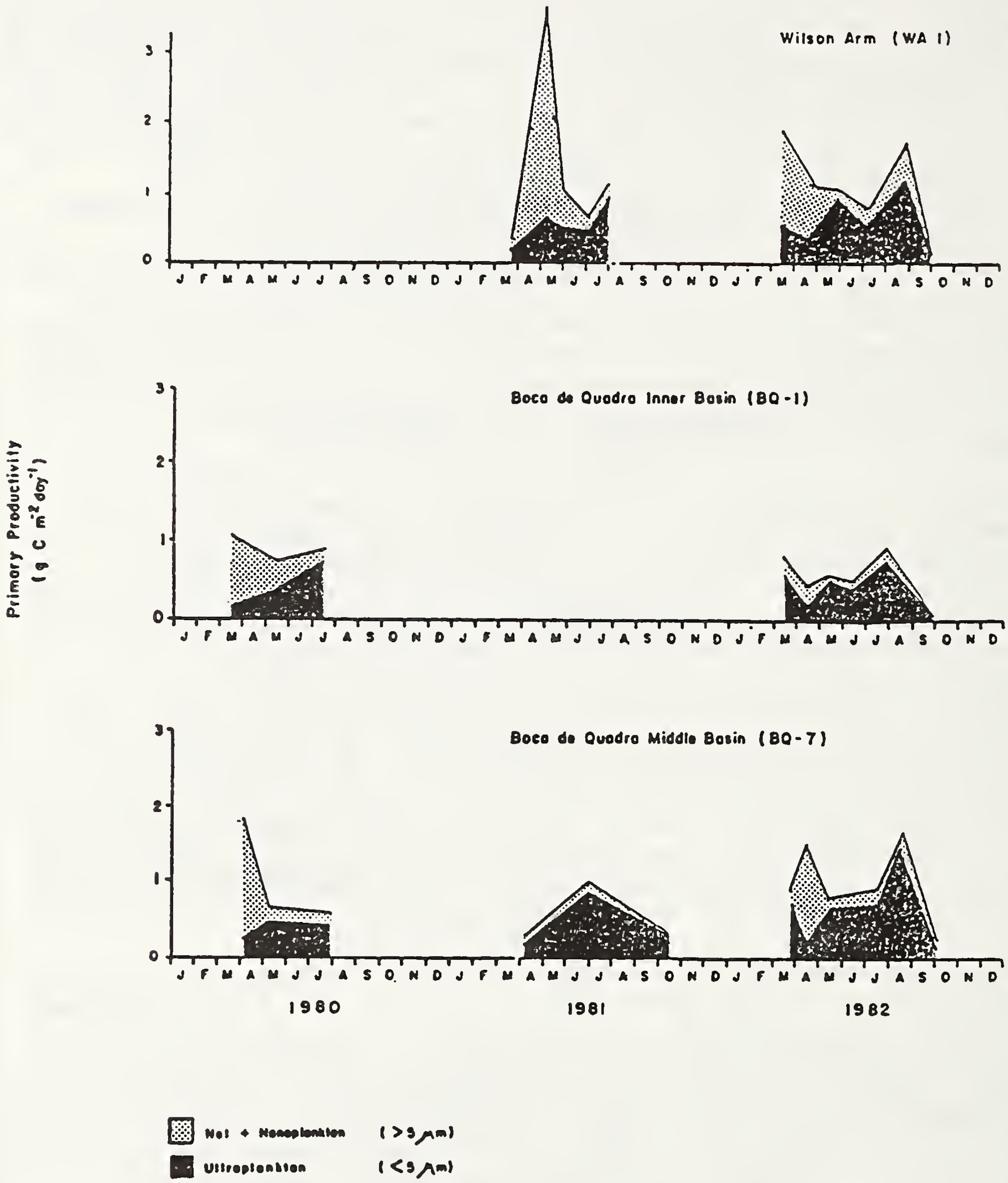
SOURCE: VTN 1980, p. 77; VTN 1981b, p. 68-69

of these spring blooms (Figure A-1). In Boca de Quadra *Skeletonema costatum* was the dominant diatom; *Thalassiosira* spp. and *Chaetoceros* spp. also contributed significantly to spring bloom productivity (VTN 1980, Fig. 3.3-1). In Smeaton Bay *Thalassiosira* spp. were by far the dominant diatoms during spring blooms and accounted for 89.8 percent of the total cell density (VTN 1981b, p. 27). Overall productivity declined by the end of May, although some dinoflagellate species (especially *Gymnodinium* spp. and *Peridinium trigueta*) became locally abundant after the decline. A second, summer bloom occurred in both fjords in 1982 primarily due to an increase in cell densities and productivity of ultraplankton (microflagellate) species (Figure A-1). However, the diatom *S. costatum* also contributed to the summer bloom in Boca de Quadra. The ultraplankton provided a substantial background of standing stock and primary production during other times of the year as well, and by conservative estimation probably fix more than one-half of the total carbon annually in these two fjords (VTN 1983b, p. 46). Many dominant microplankton species were unidentified. Key genera that were identified included *Cryptomonas* spp., *Pyramimonas* sp., *Tetraselmis* sp., and *Hemiselmis* spp. (Table A-1).

Seasonal variation in chlorophyll *a* concentrations corresponded with variations in productivity of the two major phytoplankton groups (VTN 1980, Table 3.3-2; VTN 1981b, Table 3.3-3,4,5). The relative contribution of net- and nannoplankton to total chlorophyll *a* concentration was greatest during spring blooms. During other sampling periods ultraplankton comprised a greater proportion of the total chlorophyll *a* concentration than net- and nannoplankton. The significance of the relative contributions of these two groups to productivity has been recently emphasized. A decrease in diatom/microflagellate ratio may act to decrease fish production (Greve and Parson 1977). The argument is that microflagellates support a food chain that terminates in carnivorous zooplankton species such as ctenophores or medusae, whereas diatoms support a food chain for young fish (VTN 1980, p. 50).

The timing and depth of blooms varied considerably between years and between fjords (VTN 1983b, p. 36). In Boca de Quadra the earliest bloom was observed during the last week in March 1980 and the latest spring bloom occurred during May 1981. In Smeaton Bay spring blooms occurred during April. The epicenters of the blooms were, in some cases, focused within a narrow depth range (at about 5 m) but in other cases spread more homogeneously between 2 and 10 m depth. Within-fjord annual and spatial variability tended to be as great or greater than the variability between fjords.

The factors affecting the horizontal distribution of phytoplankton were difficult to identify, but differences in hydrography of various regions appeared to play an important role. For example, within Boca de Quadra, the region downfjord of the Kite Island sill supports a plankton system that is distinctly different from that in the middle and inner basins



PRIMARY PRODUCTIVITY IN SMEATON BAY AND BOCA DE QUADRA

FIGURE A-1

SOURCE: VTN 1983b, Figures 4.1-5,6

(VTN 1983b, p. 40) due to the location of sills at the mouth and at Kite Island. Despite the influence of hydrography on horizontal distribution of phytoplankton species, differences in total primary productivity of phytoplankton between the inner and middle basins of Boca de Quadra were insignificant when compared with interannual variation within each basin (e.g. compare differences in middle basin productivity during 1981 and 1982 to between-fjord differences in 1982 [Figure A-1]). Within Smeaton Bay the phytoplankton communities at the extreme ends of the fjord were very similar, while stations near the mouth of Wilson and Bakewell Arms often supported the most distinct assemblages (VTN 1981b, p. 38).

Environmental factors controlling phytoplankton dynamics within these two fjords were similar to those acting in other fjords. They included light, nutrients, temperature, water column stability, and grazing by zooplankton. The onset of the spring bloom was associated with a seasonal increase in light combined with relatively high levels of nutrients that had been replenished during the winter by slow mixing of deep water into the upper water column and by the movement of coastal surface water into the fjord. Increased freshwater discharge from tributaries in spring resulted in a strong vertical density gradient (pycnocline) and reduced vertical mixing of the water column. By increasing residence times of phytoplankton in well-lit surface waters, the pycnocline enhanced productivity. In Boca de Quadra and Smeaton Bay the uppermost 5 m (16 ft) exhibited a strong salinity gradient during bloom periods, and these depths coincided with maximum phytoplankton density and primary production rates (VTN 1980, p. 41; VTN 1981b, p. 36).

High rates of productivity during the spring bloom resulted in reduced availability of nutrients, particularly nitrogen, phosphorus, and silicon. At some stations these nutrients were completely depleted. The effects of nutrient limitation of phytoplankton growth could be seen in low rates of assimilation of carbon per unit of chlorophyll _a_ (mg C/mg chl _a_/hr) during the decline (VTN 1980 p. 41). Regenerated nitrogen for a second summer bloom was apparently supplied in these fjords by zooplankton in the form of ammonia (VTN 1980, p. 42; VTN 1981b, p. 37). Wind mixing of deepwater nitrate-N into the euphotic zone seemed to be a less likely explanation for the regeneration of nutrients due to the strength of the pycnocline.

The two fjords did not differ significantly with respect to primary productivity or the fundamental processes affecting phytoplankton. However, since Boca de Quadra ia a larger fjord with greater spatial heterogeneity, the environmental processes may be more complex than in Smeaton Bay (VTN 1983b, p. 40).

Zooplankton

The most abundant herbivorous zooplankters within the epipelagic zone were the copepods _Pseudocalanus_ spp., _Oithona_

helgolandica, Paracalanus parvus, Acartia longiremis, and Oncaea borealis (Table A-2). These are all neritic, boreal groups that feed selectively on diatoms. Other non-selective grazers were the larvacean Oikopleura spp. the tintinnids Ptychocylis urnula and Stenosemella ventricosa, and the cladoceran Evadne sp. (Table A-2). Population fluctuations of these grazing species were closely tied to fluctuations in phytoplankton productivity, with the highest densities occurring in late spring and summer and the lowest densities occurring during the winter (VTN 1983b, pp. 47-49). An exception to this pattern was exhibited by L. helicina, which was common in spring and fall but reduced during the summer. Epipelagic herbivores contribute significantly to higher trophic levels through two major pathways. First, the larger grazers consume the larger net- and nannoplankton fractions of phytoplankton and are then preyed upon by fish. Second, the microzooplankton, principally the tintinnids, feed on microflagellates or extremely small diatoms (ultraplankton) and are then consumed by carnivorous zooplankton, which are then consumed by fish.

Epipelagic predators included medusae, ctenophores, chaetognaths, and amphipods (Table A-2). The large jellyfish Cyanea capillata was dominant with respect to biomass. The ctenophore Pleurobrachia pileus was seasonally abundant. Neither of these predators contributes to higher trophic levels; few, if any, organisms prey upon them. However, they are of ecological significance as "keystone predators" and competitors with larval and juvenile fish (VTN 1980, p. 78). The predatory amphipod Parathemisto pacifica and the chaetognath Sagitta elegans are both prey for a variety of fish. Peaks in predator populations closely followed peaks in grazer populations. By significantly reducing herbivore populations, these predators have an indirect but important impact on phytoplankton abundance.

Mesopelagic zooplankton within these two fjords included the copepods Calanus spp. and Metridia pacifica, the amphipods Parathemisto pacifica and Cyphocaris challengeri, and the euphausiids Euphausia pacifica and Thysanoessa spinifera (Table A-2). These species feed on phytoplankton and detritus that have fallen through the water column from the epipelagic zone or they consume other zooplankters. They are important prey of fish, especially young Pacific cod, sandlance, and walleye pollock (VTN 1982f, pp. 53-56). All of these species are known to migrate diurnally with the exception of P. pacifica. However, studies on diel migration in these fjords failed to document diel changes in density of these species. In Boca de Quadra only harpacticoid copepods were significantly denser near the surface in night samples (VTN 1980, p. 65); in Smeaton Bay S. elegans was the only species to exhibit a diel pattern (VTN 1981b, p. 66). Presently, the data are insufficient to draw conclusions about the extent of diel migration in these two fjords.

Of the mesopelagic species, the omnivorous euphausiids are particularly important as they are a preferred fish food. They typically are also important prey for pelagic birds and mammals,

Table A-2. Key Zooplankton Species of Boca de Quadra and Smeaton Bay

PROTOZOA
  Tintinnidae
    Ptychocylis sp.
    Stenosomella ventricosa

CNIDARIA
  Hydrozoa (medusae)
    Proboscidactyla flavicirrata
    Phialidium gregarium
  Scyphozoa
    Cyanea capillata

CTENOPHORA
    Pleurobrachia spp.

ARTHROPODA
  Cladocera
    Evadne nordmani
  Copepoda
    Acartia spp.
    Paracalanus parvus
    Pseudocalanus spp.
    Calanus marshallae
    Calanus plumchrus
    Metridia pacifica
    Oncaea borealis
    Oithona helgolandica
  Amphipoda
    Parathemisto pacifica
  Euphausiacea
    Euphausia pacifica
    Thysanoessa spinifera

CHAETOGNATHA
    Sagitta elegans

UROCHORDATA
  Larvacea
    Oikopleura spp.

Note: This list is a compilation of key species lists for the two fjords. Although all species on this list were present in both fjords, there were differences between the fjords in their relative abundance.

SOURCE: VTN 1980, pp. 77-78; VTN 1981b, pp.68-69

although these trophic relationships were not examined in Boca de Quadra and Smeaton Bay. Copepods, including *Calanus* spp., are indicator species within fjords. The relative number of *Calanus* spp. vs. other copepod groups has been used to indicate the potential for a herring fishery (Matthews and Heimdal 1980).

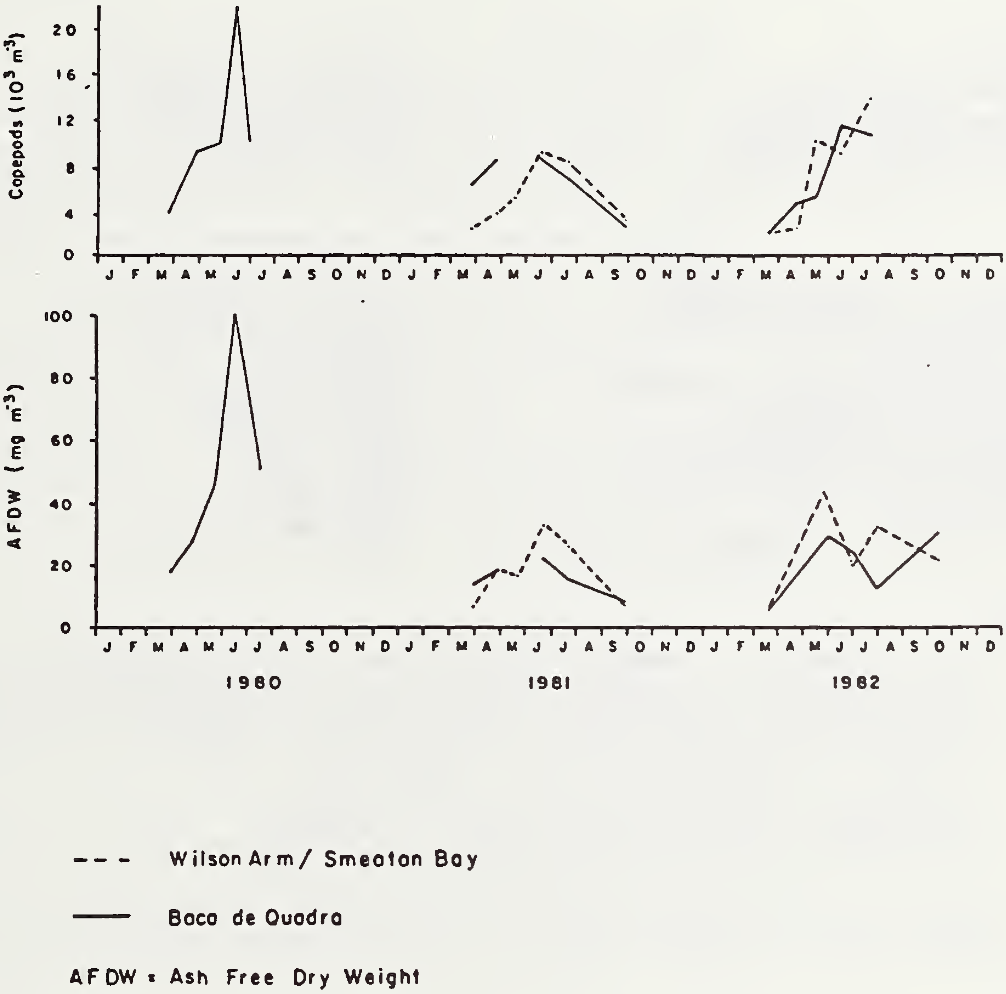
The differences in zooplankton abundance and composition between Boca de Quadra and Smeaton Bay are minor. The only statistically significant difference was a greater rate of increase in ash-free dry weight (Figure A-2) in Smeaton Bay during 1982. Apparently, the greater spatial heterogeneity of Boca de Quadra contributes to greater variability in zooplankton composition and abundance in that fjord (VTN 1983b, p. 52).

Meroplankton

The non-decapod meroplankton comprised 25 percent and 12.3 percent of all identified zooplankton in Smeaton Bay and Boca de Quadra, respectively. Molluscan larvae were the predominant group totalling 92 percent of all non-decapod meroplankton in Smeaton Bay. The combined mean density of all molluscan larvae sampled during 1981 in Smeaton Bay was comparable to the combined mean density of all calanoid copepod taxa (VTN 1981b, Table 3.3-10). Hence, this group is a major component of epipelagic and mesopelagic food webs, although there is presently little information regarding the contribution of this group to higher trophic levels.

Other meroplankton groups were echinoderm, polychaete, barnacle, and decapod crustacean larvae (Table A-3). Of the latter group, the larvae of Dungeness crab (*Cancer magister*), Tanner crab (*Chionoecetes bairdi*) and shrimp of the genus *Pandalus* are life history stages for species of potential commercial value.

Fish larvae (ichthyoplankton) tended to be most abundant during the spring. They included the larvae of herring, walleye pollock, rockfish, flatfish, smelt, smoothtongue, and sandlance (Table A-3). Herring and pollock spawn outside of the fjord, while rockfish and most flatfish spawn in the fjords. Rock sole are thought to spawn in the outer regions of the fjords (VTN 1983b, p. 56-57). Additional information on ichthyoplankton can be found in Appendix C.



COPEPOD DENSITY AND ASH FREE DRY WEIGHT IN SMEATON BAY AND BOCA DE QUADRA

FIGURE A-2

SOURCE: VTN 1983b, Figure 4.1-10

Table A-3. Key Meroplankton and Ichthyoplankton Species in Boca de Quadra and Smeaton Bay

MOLLUSCA

Gastropod larvae
Bivalve larvae

DECAPODA

Pandalus spp.	Pandalid shrimps
Cancer magister	Dungeness crab
Chionoecetes bairdi	Tanner crab
Munida quadrispina	Pinch bug crab

PISCES

Clupea harengus pallasi	Pacific herring
Theragra chalcogramma	Walleye pollock
Scorpaenidae	Rockfish
Hippoglossoides elassodon	Flathead sole
Parophrys vetulus	English sole
Lepidopsetta bilineata	Rock sole
Ammodytes hexapterus	Sandlance
Osmeridae	Smelt
Bathylagus stilbius	Smoothtongue

Note: This list is a compilation of key species lists for the two fjords. Although all taxa on this list were present in both fjords, there were differences between fjords in their relative abundance.

SOURCE: VTN 1980, p. 77-78 and Table 3.3-10;
VTN 1981b, p. 68-70 and Table 3.3-10.

Appendix B

BENTHIC RESOURCES

Introduction

Benthic invertebrates are an ecologically and commercially valuable resource. Many invertebrate taxa function as major components of food webs as links between primary producers and organisms at higher trophic levels, including seals, whales, birds and fish. Some invertebrates, such as shrimp and crab, are commercially harvested for human consumption.

Within Smeaton Bay and Boca de Quadra fjords, there are several types of benthic habitat, each of which supports a characteristic assemblage of invertebrate taxa. These habitat types are: 1) rocky intertidal, 2) rocky subtidal, 3) soft-bottom intertidal, and 4) soft-bottom subtidal (VTN 1983b, p. 48). Within each of these habitat types, key species have been identified as either ecologically and/or commercially important (VTN 1980, pp. 252-257). No unique benthic invertebrates have been identified in either fjord (Envirosphere 1984, p. 3-68).

The key species of rocky intertidal habitats include barnacles, mussels, and rockweed (Fucus). Barnacles and mussels are ecologically important as prey for many organisms, including some (e.g., birds, otters, mink) from other habitats (VTN 1983b, p. 61, Figure 5.3-4). They are also important producers of planktonic larvae which are, in turn, prey for a variety of pelagic fish. Rockweed is of major ecological importance as a source of carbon in the form of detritus that is utilized as food by a variety of benthic and pelagic organisms. All three of these key species provide a habitat for many other taxa, including some, such as chironomids, that are consumed by commercially harvested fish species.

Within the rocky subtidal habitat, kelp are a particularly valuable resource. Kelp provide detritus and dissolved organics that are utilized by many organisms, including some of potential commercial importance (e.g., abalone, sea urchins, and shrimp). Kelp beds are also an important spatial resource utilized by fish, shrimp, and crabs. Some of the invertebrate species within subtidal rocky areas are ecologically important as top predators that regulate the abundances of other benthic species.

Sedge (Carex), rockweed (Fucus), and eelgrass (Zostera) are key species within soft-bottom intertidal habitats at the heads of the two fjords. All of these species are important sources of carbon and provide a spatial refuge for many species, including

herring and outmigrating salmon. They also harbor a diverse and abundant assortment of invertebrate species (including harpacticoid copepods and insects) that are major food items in the diets of fish, birds, and mammals. A species of potential commercial importance found within this habitat is the soft-shell clam, *Mya arenaria*.

Subtidal, soft-bottom habitats are the most extensive of all benthic habitats comprising the major portion of the fjord basins. This habitat supports the largest number of infaunal taxa, many of which are prey for bottom fish, including flathead sole, English sole, and halibut. Commercially important epifaunal invertebrates, including several species of shrimp (spot and coonstripe) and Dungeness crab, are concentrated in the shallow and mid-depth regions of this habitat. The shallow and mid-depth areas also support the largest number of species and the greatest overall abundance of infaunal invertebrates. Deeper benthic areas of both fjords support a greater infaunal biomass than shallower areas, but this is due to the presence of large echinoderms that are of no commercial value and do not serve as a food source for higher taxa. The food webs of deep benthic communities are relatively isolated from other communities within the fjords.

The distribution of habitat types within Boca de Quadra and Smeaton Bay is comparable with two notable exceptions. Although Boca de Quadra is twice as large (in terms of surface area) as Smeaton Bay, the soft-bottom intertidal and estuarine habitat areas at the head of Boca de Quadra are limited when compared to similar areas at the head of Wilson Arm. The Wilson Arm estuary is the largest in southeast Alaska (Envirosphere 1984, p. 3-68). A second difference in the distribution of benthic habitat types is related to differences in the topographies of the two fjord basins. In Boca de Quadra, shallow and mid-depth communities (0-200 m [0-660 ft]) are found within an inner basin that is physically separated from a deeper middle basin community (200-400 m [660-1300 ft]) by a shallow sill (110 m [360 ft]). In Smeaton Bay the three soft-bottom subtidal community types grade into one another with no physical barriers.

Baseline studies of the benthic habitats and their fauna were conducted in Smeaton Bay in 1980-81, and in Boca de Quadra in 1979-80. Additional monitoring studies were conducted in subsequent years. Since mill tailings disposal at the proposed depth would have the greatest impact on deep benthic communities, this summary will focus on the soft-bottom subtidal habitat and associated fauna, although the major characteristics of the remaining three habitat types will also be briefly described.

Description of Habitat Types and Associated Biota

Rocky Intertidal Habitat

Surveys of both fjords identified dominant species and associated environmental factors that affect zonation patterns, e.g., intertidal height, substrate angle, and current velocity. The results of these surveys were similar for the two fjords. Rocky intertidal habitats of several types were distributed along most of the perimeter of each fjord. Some areas consisted of rock benches with surface angles ranging from nearly vertical to horizontal; other rocky habitats were composed of boulder or cobble areas on sandy beaches. Rocky intertidal areas were dominated by rockweed (*Fucus distichus*), acorn barnacles (*Balanus glandula*), bay mussels (*Mytilus edulis*), and turf algae of several species, including *Odonthallia* spp., *Rhodoglossum affine*, and filamentous red algae (VTN 1981b, p. 161; VTN 1980, p. 170). In general, rockweed was most abundant at higher tidal levels on gradual slopes, whereas barnacles and mussels were most abundant at lower tidal levels and on more vertical slopes. Mussels were most abundant at headlands and other areas where current velocities were greater. Turf algae occupied the lowest intertidal levels on gradual slopes. The understory organisms were comprised primarily of arthropods and molluscs. Overall seasonal fluctuations in the rocky intertidal fauna were low in both fjords, although certain species (e.g., mussels) fluctuated to some extent.

Zonation patterns in Smeaton Bay and Boca de Quadra were comparable. However, the patterns within these fjords differ from those on the exposed, outer coast, where there are typically four zones (VTN 1981b, p. 162). The difference in zonation patterns in fjords can be attributed to lower salinities that exclude certain dominant oceanic species. Breaks in the zonational patterns occurred near the open ends of Boca de Quadra and Smeaton Bay. In the regions downfjord from these breaks, additional oceanic species were present in rocky intertidal zones.

Rocky Subtidal Habitat

Three major types of rocky subtidal habitat were identified in the two fjords: (1) vertical rock walls; (2) sand-dominated substrates on gradual slopes (located near the heads of the fjords); and (3) mixed rock/sand habitats with interspersed boulders. Each of these habitat types was occupied by characteristic assemblages, and within each habitat the distribution of organisms varied with respect to depth (VTN 1983b, pp. 66-68).

On vertical walls at shallow depths (0-3 m), the community was dominated by red algae; at mid-depths (3-7 m), kelps, crustose algae, chitons, and gastropods were dominant; and at deeper depths (> 7m), tunicates, brachiopods, polychaetes, and large filter-feeding crinoids were dominant. Additional factors

that modified the relative abundance of these organisms included substrate angle, amount of sediment present, current velocity, and biological interactions (e.g., predation, competition).

Sandy substrates with gradual slopes were dominated by eelgrass (Zostera) at shallow sites. Bivalves, crinoids, sun stars (Pycnopodia), and isolated patches of kelp occurred in deeper waters.

The third habitat type consisted of a mosaic of rock and soft substrate assemblages (VTN 1980, Tables 5.3-6 through 5.3-8; VTN 1981b, Tables 5.3-6). Seasonal changes in species abundance occurred in both fjords as a result of many interacting factors, including seasonal reproductive and migratory patterns, and seasonal changes in salinity, temperature, and nutrient availability (VTN 1983b, pp. 68-70).

A comparison of the two fjords indicated differences in the distribution of the three types of rocky subtidal habitat. Boca de Quadra is a long fjord that drops off abruptly at the head. As a consequence, there are more rock wall areas, fewer sand and mixed sand/rock habitats, and fewer kelp beds in Boca de Quadra than in Smeaton Bay.

Soft-bottom Intertidal Habitat

Soft-bottom intertidal habitats, located at the heads of Wilson Arm, Bakewell Arm, and Boca de Quadra, were composed primarily of silt and clay with very little sand, gravel, or cobble. Three intertidal zones were identified within these areas: sedge (Carex), rockweed/cobble, and sand/mud. An herb/grass zone was also present above the intertidal zone in both fjords and was most developed in the upper Wilson estuary (VTN 1983b, pp. 73-75).

A variety of small invertebrates, including polychaetes, oligochaetes, molluscs, and crustaceans, were found in the intertidal zones. The greatest species richness occurred in the rockweed/cobble zone, possibly because of greater spatial heterogeneity (VTN 1983b, pp. 76-77). There were strong seasonal changes in abundances of certain invertebrate taxa, such as molluscs and polychaetes, and these changes probably reflected seasonal changes in salinity and temperature.

The distribution of the dominant zones differed for Wilson Arm, Bakewell Arm, and Boca de Quadra. The mudflats at the heads of Boca de Quadra and Wilson Arm are fed by relatively large rivers that deposit great amounts of sediment. Therefore, the mudflat and marsh areas of these two fjords were more extensive than in Bakewell Arm (VTN 1983b, p. 78). The Wilson estuary and soft-bottom intertidal area is more extensive than that of Boca de Quadra.

A second difference related to the distribution of eelgrass (Zostera) beds. A bed of significant size was present in the

Wilson estuary away from the influx of the Wilson River and the effects of heavy sediment loads. A small eelgrass bed was present in the middle of the Bakewell mudflats. No eelgrass beds were found in the lower mudflats of Boca de Quadra, probably because of a lack of shallow substrates where eelgrass could become established in areas away from the influx of the Keta River.

Soft-bottom Subtidal Benthos

Infauna. Soft-bottom subtidal stations were surveyed in baseline studies during 1979-80 in Boca de Quadra and 1980-81 in Smeaton Bay. Additional monitoring studies were conducted in both fjords during 1981-82. Also sampled were Mink and Vixen Bays (extensions of Boca de Quadra), and Bakewell Arm (an extension of Smeaton Bay). Data on species composition, abundance, and biomass were obtained from 34 stations in Boca de Quadra and 17 stations in Smeaton Bay, although only a portion of these were sampled more than once to monitor seasonal changes. Grain-size distribution and total organic carbon content of the sediment were determined for representative sampling stations. Data on depth, temperature and dissolved oxygen concentrations were also collected.

Infauna were sampled using a 0.1 m^2 Van Veen bottom grab for silt/clay sediments and a 0.1 m^2 Smith-McIntyre grab for coarser sediments. Grab samples were sieved, and the organisms retained on the screen were identified to the lowest practical taxonomic level, enumerated, and weighed (wet weight). The sampling procedures were identical for both fjords with one major, significant difference: the mesh size of the screens differed during baseline studies. Boca de Quadra samples (1979-80) were sieved through 0.5 mm mesh screen, whereas Smeaton Bay samples were sieved through 1.0 mm mesh screen. During later monitoring studies (1981-82) sampling procedures for the two fjords were standard (all samples sieved through 1.0 mm mesh screens). The biological data from these grab samples were analyzed to determine species richness (number of species), species diversity (Shannon-Wiener index), individual abundance, evenness (the distribution of abundance among species), species biomass, and total biomass. Recurrent faunal assemblages (communities) were identified using classification analyses (VTN 1980, pp. 155-162; VTN 1981b, pp. 153-158).

Samples for analyzing grain-size distribution and total organic content of the sediments were taken from undisturbed grab samples by inserting corers through the top of the sample prior to sieving. Sediment grain size was determined using standard methods (Folk 1974). Total organic carbon was determined by two methods: (1) weight loss during ignition (combustible solids), and (2) weight loss through digestion with H_2O_2 (digestible solids). Also, the volume of organic material retained on a 0.25 mm mesh screen was measured (VTN 1980, p. 161; VTN 1981b, p. 157).

An examination of the infaunal communities with respect to depth showed several trends common to both fjords. Infaunal communities were of three types: shallow (20-100 m), mid-depth (100-200 m), and deep (>200 m). The shallow and mid-depth communities only were found within the inner basin of Boca de Quadra, separated by a sill from the deep community of the middle basin. In contrast, the three community types within Smeaton Bay graded into one another with no distinct physical barriers (Figure 4-1). Each community type could be defined by several interrelated traits such as characteristics of the sediment and biological community parameters.

The three community types differed with respect to mean grain size, total organic carbon content of the sediment, and volume of organic material (Table B-1). The shallow benthic communities of both fjords had the coarsest sediments, while the finest sediments were found in the Boca de Quadra middle basin and the deepest areas of Smeaton Bay. Trends in organic carbon content of the sediment and volume of organic material were similar for the two fjords. Sediments at shallow depths were least organically rich as indicated by measures of combustible solids, but shallow sediments possessed the greatest volume of organic material retained on a 0.25 mm mesh sieve. The sediments of mid-depth and deep communities were increasingly rich as measured by percentage combustible solids, but they possessed less organic material by volume (Table B-1). This reflects differences in the sources of organic material to the two community types. River-carried, terrestrial debris and decomposing macroalgae provide a large proportion of carbon to shallow areas, while deep areas receive carbon from epipelagic zones in the form of detrital rain.

There were significant differences between the three community types with respect to the following biological measures: species richness, species diversity, species evenness, density, and biomass (Table B-2). It must be emphasized that between-fjord comparisons in these measures cannot be made using baseline data because: 1) Boca de Quadra samples were sieved through a smaller mesh screen than Smeaton Bay samples, and 2) the samples were taken during different years. However, comparisons among the communities within each fjord can be made, and these major trends can then be compared between fjords.

In both fjords, the shallow and mid-depth benthic communities were most species-rich. That is, the Boca de Quadra inner basin and the shallower portions of Smeaton Bay (including Wilson Arm) support higher numbers of species than Boca de Quadra middle basin and the deeper portions of Smeaton Bay (Table B-2), respectively. Species diversity was greatest in mid-depth communities in both fjords. However, in Boca de Quadra, species diversity of shallow and deep communities did not differ significantly. In Smeaton Bay, deep communities were more diverse than shallow communities. This was due to the more even distribution of abundance among the species present in deeper communities. In both fjords, values of evenness increased with

Table B-1. Sedimentary characteristics of major softbottom, subtidal benthic community types in Boca de Quadra and Smeaton Bay[a]

	Smeaton Bay					Boca de Quadra				
	Station	Depth (m)	Mean Grain Size (Ø)	Total Organic Carbon (% wt)[b]	Total Organic Material (% vol.)[c]	Station	Depth (m)	Mean Grain Size (Ø)	Total Organic Carbon (% wt.)	Total Organic Material (% vol.)
Shallow										
	WA000	16	2.15	0.29	22.4	BQ020	35	3.98	2.04	24.0
	WA002R	50	3.64	2.04	38.6	BQ021	35	4.57	2.76	27.0
	WA002L	54	4.22	2.37	21.5	BQ022	35	3.45	1.34	12.5
	WA002C	57	3.65	2.27	14.4	BQ040	70	3.91	2.14	27.0
	WA005	93	4.68	3.19	13.1	BQ041	70	5.17	3.96	18.6
						BQ042	70	4.95	2.88	23.9
						BQ100	95	5.96	3.60	16.7
						BQ101	90	5.85	3.89	20.0
						BQ102	90	5.44	3.28	9.7
Mid-Depth										
	WA010	115	5.22	4.21	9.4	BQ200	150	7.20	4.00	3.7
	WA040	132	7.00	3.31	4.6	BQ201	145	6.94	4.06	2.8
	WA060	155	7.50	4.0	4.5	BQ202	150	7.00	4.17	2.1
						BQ203	150	6.67	4.01	5.3
						BQ401	140	4.54	2.66	2.3
						BQ412	130	7.19	4.25	10.0
Deep										
	SB010C	241	8.11	4.07	0.7	BQ500	210	6.28	3.37	7.3
	SB030	245	7.95	4.25	1.7	BQ501	195	7.89	4.89	4.0
	SB050	256	7.39	3.75	5.3	BQ502	195	7.52	5.09	3.9
	SB070	265	7.26	3.50	3.6	BQ600	280	7.76	4.44	3.3
						BQ601	275	7.43	4.72	5.8
						BQ602	275	8.51	4.08	3.2
						BQ700	280	8.28	3.77	2.2
						BQ701	275	7.86	4.66	5.0
						BQ702	280	8.38	4.60	6.3
						BQ800	330	8.30	3.32	1.9
						BQ801	330	8.06	4.61	3.4
						BQ802	380	7.20	4.02	4.7

a Compiled from VTN 1980, Tables 5.3-20,21; VTN 1981b, Tables 5.3-12,13.
b Combustible.
c Material retained on a 0.25 mm mesh sieve.

Table B-2. Biological characteristics of three major community types in Boca de Quadra and Smeaton Bay[a].

COMMUNITY TYPE	SPECIES RICHNESS[b]		SPECIES DIVERSITY[c]		EVENNESS		NUMBER OF INDIVIDUALS[d]		TOTAL BIOMASS[d]	
	BQ	SB	BQ	SB	BQ	SB	BQ	SB	BQ	SB
Shallow (20-100m)	47	20.8	2.8	1.84	0,72	0.63	1336	360	68.50	59.9
Mid-depth (100-200m)	49	23.3	3.0	2.45	0.76	0.81	513	110	98.16	79.2
Deep (200+m)	31	20.3	2.7	2.34	0.78	0.84	280	79	92.9	155.2

(a) Compiled from VTN 1980, Table 5.3-26 and VTN 1981b, Table 5.3-15. Shown are means of values obtained from seasonal sampling.
(b) Values are mean number of species per 0.1 m^2.
(c) Shannon-Wiener species diversity index.
(d) Values are mean number of individuals per 0.1 m^2
(e) Values are wet weights/m^2

NOTE: These figures are based on data taken during baseline sampling periods. Since sampling procedures and years of sampling were different for the two fjords, between-fjord comparisons of values in this table cannot be made. However, the communities within each fjord may be compared with respect to major biological characteristics, and observed trends may then be compared between fjords (see text for discussion).

increasing depth (Table B-2). This is due to the presence of certain polychaete groups at shallow depths that were particularly abundant (dominant). In general, infaunal densities were greatest in shallow water communities and decreased with increasing depth.

Values of total biomass showed the opposite pattern, however. They increased with increasing depth in Smeaton Bay and increased from shallow to mid-depth areas in Boca de Quadra, then decreased slightly from mid-depth to deep communities. This trend in biomass values is better understood by considering biomass values of five major taxonomic groups (polychaetes, molluscs, crustaceans, echinoderms, and other invertebrates) with respect to depth. Polychaete and mollusc biomass values were significantly greater in shallow than in mid-depth and deep communities. In contrast, echinoderm biomass values were significantly greater for deep communities due to the presence of large, detritus-feeding heart urchins (*Brisaster latifrons*) and mudstars (*Ctenodiscus crispatus*) (VTN 1980, Table 5.3-27; VTN 1981b, Table 5.3-16). It should be noted that polychaetes and molluscs are prey for a variety of invertebrate and vertebrate groups, while few organisms prey on heart urchins and mudstars.

There were no significant differences in the species composition of the two fjords. Although many more species were present in samples taken during baseline studies from Boca de Quadra, this can certainly be attributed to the smaller mesh size of the screens used to sieve grab samples. With only two exceptions (*Levinsenia gracilis* and *Ophelina breviata*), the most abundant species within each community type in Smeaton Bay were found within the same community type in Boca de Quadra (Table B-3). No unique species were identified from either fjord (Envirosphere 1984, p. 3-68).

Oxygen values remained above 4 mg/l throughout the baseline sampling periods in Smeaton Bay and Boca de Quadra. This value exceeds levels necessary for survival of marine organisms. During a subsequent monitoring period (March-May, 1982), the oxygen levels in both fjords fell below this level, and this was associated with reduced infaunal abundance in both fjords (VTN 1983b, pp. 83-87). Shallow and mid-depth communities recovered to previous levels of abundance more rapidly than deep communities, and recovery in the Smeaton Bay deep community was more rapid than in the middle basin of Boca de Quadra.

In Boca de Quadra there were distinct seasonal patterns of abundance, species richness, and diversity. Abundances and species richness were greater in winter and spring than in summer and fall for all three community types. Species diversity, however, increased in winter and spring in mid-depth and deep communities but decreased in shallow communities. This was attributed to an increase in the dominance of polychaetes (VTN 1980, pp. 244-246). In Smeaton Bay, subtidal stations were not sampled during the winter nor were they sampled during the same year as Boca de Quadra, so a direct comparison of seasonal

Table B-3. Most abundant infaunal species from three major soft bottom community types in Boca de Quadra and Smeaton Bay[a]

	S	M	D
Annelida			
Polychaeta			
Pholoe minuta			X
Anaitides groenlandica	X		
Eteone sp.	X		
Podarkeopsis brevipalpa		X	
Ancistrosyllis groenlandica			X
Nereis sp.	X		
Nephtys cornuta cornuta	X	X	X
Nephtys punctata		X	X
Aglaophamus malgreni		X	X
Sphaerodoridium cladaredii	X		
Glycera capitata	X		
Lumbrineris luti			X
Ninoe simpla		X	X
Haploscoloplos elongatus		X	X
Aricidea nr. *suecica*	X	X	
Aricidea lopezi lopezi		X	X
Aricidea quadrilobata		X	
Levinsenia gracilis[b]	X	X	X
Prionospio steenstrupi	X	X	
Minuspio cirrifera	X	X	X
Chaetozone setosa		X	
Cossura longocirrata		X	
Cossura laeviseta		X	
Tharyx sp.	X		
Ophelina acuminata	X		
Ophelina breviata[b]	X	X	
Mediomastus californiensis			X
Maldanidae spp.	X	X	
Maldane glebifex		X	
Euclymene delineata	X		
Ampharete acutifrons	X	X	
Melinna cristata		X	
Terebellides stroemi		X	
Euchone arenae		X	
Nemertina			
unidentified species	X	X	

	S	M	D
Mollusca			
Aplacophora			
Chaetoderma sp.			X
Bivalvia			
Nucula tenuis			X
Yoldia scissurata	X		
Thyasira gouldi		X	X
Adontorhina sp. nova		X	X
Adontorhina cyclia		X	
Axinopsida serricata	X		
Macoma sp.	X		
Macoma eliminata	X		
Scaphopoda			
Cadulus sp.		X	
Arthropoda			
Crustacea			
Ostracoda spp.		X	
Copepoda spp.	X	X	
Cumacea			
Eudorella pacifica	X	X	
Diastylis pellucida	X		
Amphipoda			
Heterophoxus oculatus		X	
Bathymedon sp. A	X		
Bathymedon nr. *pumilus*		X	
Synchelidium nr. *shoemakeri*		X	
Harpinopsis fulgens		X	
Echinodermata			
Echinoidea			
Brisaster latifrons			X
Asteroidea			
Ctenodiscus crispatus			X

[a] This list was prepared by selecting the most abundant species within each community type in Smeaton Bay. With the exception of species marked with (b), all species were present in comparable communities at Boca de Quadra.

[b] This species was not present in Boca de Quadra samples.

S - Shallow (20-100m)
M - Mid-depth (100-200m)
D - Deep (200+m)

SOURCE: VTN 1980, Figures 5.3-29 through 32; VTN 1981b, Figure 5.3-27

patterns in the two fjords is not possible. In general, the available data suggest seasonal changes were not as clearly defined in Smeaton Bay as in Boca de Quadra. The highest seasonal values for total number of specimens in Smeaton Bay were recorded in March 1981, which coincided with a time of peak polychaete biomass in shallow and mid-depth communities. Species diversity values were greatest during September 1981 in shallow and deep communities; this may have been due, in part, to the relatively low abundance (biomass) of dominant species during those periods (VTN 1981b, p. 197).

Epifauna. Epifaunal assemblages were sampled in Smeaton Bay and Boca de Quadra using otter trawls (for depths from 50-150 m), crab pots (25-300 m), and shrimp pots (50-175 m) (VTN 1980, pp. 81-85; VTN 1981b, pp. 72-76). All invertebrates were identified to lowest practical taxonomic level. Shrimp and crabs were sexed and counted. Additional data (length, weight, molt condition) were recorded as time allowed. Abundances were expressed as catch per unit effort (CPUE) in units of kg/km for trawls and kg/day for pots. A community analysis program was used to identify major assemblages (Table B-4) that corresponded in depth range to the three infaunal assemblages.

Epifaunal assemblages sampled by trawl differed with respect to depth in both fjords. Shallow and mid-depth assemblages were found in the inner basin of Boca de Quadra and in Wilson Arm, while deep assemblages were found in Boca de Quadra middle basin and deeper areas of Smeaton Bay (VTN 1983b, p. 110). Shallow and mid-depth epifaunal assemblages were richer in total number of species and abundances of commercially important species than deep assemblages. They were characterized by several species of shrimp, Dungeness crabs, and Tanner crabs. Deep assemblages were characterized by sidestripe shrimp, Tanner crabs, and echinoderms. Echinoderms comprised a large percentage of the total biomass of the deep assemblage (VTN 1983b, p. 110).

In view of the differences in sampling gear used to collect different species, it is difficult to quantitatively compare species abundances. However, it is possible to compare abundances of a single species within different areas of a fjord. Limited data are available for making between-fjord comparison of epifaunal abundance, as both fjords were sampled simultaneously during the monitoring studies of 1981-83. However, the data are insufficient to draw conclusions regarding the long-term relative abundance of epifaunal species in the two fjords.

Key Epifaunal Species

Dungeness Crab (Cancer magister)

Dungeness crabs are ecologically important in the food webs of estuarine, soft-bottom intertidal, and subtidal benthic habitats. They are scavengers that consume detritus and a variety of benthic invertebrates. In turn, they are prey for

Table B-4. Major Taxa of the Three Epifaunal Assemblages Found in Boca de Quadra and Smeaton Bay

ASSEMBLAGE	MAJOR TAXA
Shallow (20-100 m)	Arthropoda
	Crustacea
	Decapoda
	Natantia (shrimps)
	Pandalopsis dispar (sidestripe shrimp)
	Pandalus borealis (pink shrimp)
	Pandalus hypsinotus (coonstripe shrimp)
	Pandalus platyceros (spot shrimp)
	Reptantia (crabs)
	Cancer magister (Dungeness crab)
	Chionoecetes bairdi (Tanner crab)
	Munida quadrispina (pinch bug crab)
Mid-depth (100-200 m)	Arthropoda
	Crustacea
	Decapoda
	Natantia (shrimps)
	Crangon spp. (crangon shrimps)
	Pandalopsis dispar (sidestripe shrimp)
	Pandalus borealis (pink shrimp)
	Pandalus hypsinotus (coonstripe shrimp)
	Pandalus platyceros (spot shrimp)
	Reptantia (crabs)
	Chionoecetes bairdi (Tanner crab)
Deep (200-330 m)	Arthropoda
	Crustacea
	Decapoda
	Natantia (shrimps)
	Pandalopsis dispar (sidestripe shrimp)
	Pandalus borealis (pink shrimp)
	Reptantia (crabs)
	Chionoecetes bairdi (Tanner crab)
	Echinodermata
	Asteroidea (starfishes)
	Ctenodiscus crispatus (mud star)
	Echinoidea (sea urchins)
	Brisaster latifrons (heart urchin)

SOURCE: VTN 1983b, Table 5.3.2.

river otter, mink, harbor seals, rockfishes, and dogfish in near-shore and estuarine habitats, and Pacific halibut in deeper benthic habitats (VTN 1983b, Figures 5.3-5.6). Dungeness crabs are commercially harvested in both Boca de Quadra and Smeaton Bay. The average reported annual catch between 1969-78 of mature males (carapace >176 mm) was 2,345 lbs in Boca de Quadra and 519 lbs in Smeaton Bay (VTN 1980, p. 131; VTN 1981b, p. 138).

In both fjords juveniles and adults were found primarily at shallow depths (<100 m) and juveniles were often found in the eelgrass beds of Wilson estuary (Envirosphere 1984). During 1980-81 the mean CPUE of Dungeness crabs (sampled with pots) was greater for Wilson Arm than for Boca de Quadra inner basin during four of five sampling periods, while the catch in deeper areas of Smeaton Bay exceeded that of the Boca de Quadra middle basin during all of four sampling periods (VTN 1983b, Fig. 4.3-5). It should be noted, however, that within-fjord seasonal variability in catch was great (e.g., mean CPUE for Wilson Arm decreased from 14.0 to 2.0 between March and September 1981) and exceeded, in some cases, between-fjord differences in mean CPUE.

Tanner Crab (*Chionoecetes bairdi*)

Tanner crabs are ecologically important in the food webs of subtidal benthic habitats. They consume detritus and are prey for spiny dogfish and Pacific halibut. Although male Tanner crabs >140 mm (carapace width) may be harvested commercially, very few crabs >140 mm were found during baseline studies in Boca de Quadra and Smeaton Bay.

Tanner crabs were collected with all gear types from all sampling areas of both fjords. In Wilson Arm the smallest individuals were caught in trawls near the shallow head of Wilson Arm; the intermediate sizes were caught in shrimp pots near the edges of the fjord basin; while the largest crabs were caught in Tanner crab pots in the deeper, central areas of the basin (VTN 1981b, p 140). In both fjords, Tanner crabs were relatively rare at shallower depths (<100 m); these areas were dominated by Dungeness crabs. Tanner crabs and Dungeness crabs co-existed at depths of 100-150 m, while only Tanner crabs were found at depths >150 m. They were least abundant in the deepest areas, such as the outer part of the Boca de Quadra middle basin (VTN 1983b, pp. 118-119). The catch rates for Tanner crabs in Boca de Quadra and Smeaton Bay were comparable during 1981-82 (VTN 1983b, p. 119).

Spot Shrimp (*Pandalus platyceros*) and Coonstripe Shrimp (*Pandalus hypsinotus*)

Spot and coonstripe shrimp are the only commercially harvested shrimp species in the two fjords. The peak annual commercial value of shrimp captured using shrimp pots exceeds $56,000 and $11,000 in Boca de Quadra and Smeaton Bay, respectively (Envirosphere 1984, p. 3-81). These shrimp are ecologically important; they feed on detritus and a variety of

marine invertebrates and are, in turn, prey for a variety of fish.

Spot and coonstripe shrimp were captured in shallow trawls in both fjords, but most were collected with shrimp pots. The greatest abundance of these species was found along the sides of the fjord basins in areas inaccessible to trawl gear (VTN 1983b, p. 120).

Other Shrimp

Other major shrimp species in both fjords included the sidestripe shrimp (*Pandalopsis dispar*) and pink shrimp (*Pandalus borealis*). Neither species is commercially harvested. Both species consume detritus and benthic invertebrates and are prey for a variety of fish.

Sidestripe shrimp were sampled only in trawls, as this species is not attracted to baited pots. It was a dominant species in all areas trawled in both fjords (VTN 1983b, p. 120). It was present even in the deeper areas of the middle basin of Boca de Quadra and Smeaton Bay, areas not inhabited by other shrimp species. Pink shrimp were captured in trawls and shrimp pots; they were often numerically abundant in trawls, but did not represent a major part of the community biomass (VTN 1983b, p. 120).

Appendix C

FISH RESOURCES

Introduction

Fishes play an important role in community structure and dynamics. Predation by fishes influences the abundance of organisms such as molluscs, polychaetes, epibenthic and planktonic crustaceans, and other fishes. In turn, fishes are a major food source for other fishes, marine birds, and mammals. Environmental factors such as climate and oceanographic conditions also affect survival and recruitment of fishes.

Although the Gulf of Alaska supports approximately 287 species of fish belonging to 55 families, only 75 species have been observed in Boca de Quadra and Smeaton Bay (Table C-1). Fish families of economic or ecological importance in Boca de Quadra and Smeaton Bay include Salmonidae (salmon, trout, and char), Clupeidae (herring), Pleuronectidae (flatfish), Gadidae (codfish), Scorpaenidae (rockfish), Stichaeidae (pricklebacks), Cottidae (sculpins), Zoarcidae (eelpouts), Osmeridae (smelts), Ammodytidae (sandlances), and Squalidae (sharks) (Envirosphere 1984, p. 3-70). The dominant fishes in terms of abundance are herring, pink salmon, chum salmon, and sandlance in the pelagic zone, and flathead sole, English sole, slender sole, walleye pollock, and longsnout prickleback in the epibenthic zone (VTN 1983b, p. 94; Envirosphere 1984, pp. 3-62 and 3-70).

In comparing the two fjords, demersal fish species composition tends to be similar within the same habitat type. Wilson Arm and the inner basin of Boca de Quadra are comparable in depth range and composition of demersal fishes, while Smeaton Bay and the middle basin of Boca de Quadra are both relatively deep and contain similar fish species (Figure C-1). Bakewell Arm is intermediate in depth to the aforementioned areas and supports a mixture of shallow and deepwater demersal fish species. Common species of the shallower basins (inner Boca de Quadra and Wilson Arm) include several flatfishes, walleye pollock (*Theragra chalcogramma*), eelpouts, and sculpins. The deeper basins (middle Boca de Quadra and Smeaton Bay) are characterized by fewer demersal fish species. Little is known about adult fishes in the epipelagic or mesopelagic zones throughout both fjords (VTN 1983b, p. 91).

A quantitative comparison of demersal fish abundance between fjords is not reasonable because of differences in the sampling vessel utilized in each fjord and differences in year of intensive sampling (Fishman pers. comm.). However, comparison of

Table C-1. Fish Species Identified from Boca de Quadra and Wilson Arm/Smeaton Bay

TAXON	COMMON NAME	LOCATION
Family Squalidae		
Squalus _acanthias_	Spiny dogfish	WS
Family Rajidae		
Raja sp.	Skate egg case	BDQ
Raja _binoculata_	Big skate	BDQ
Raja _rhina_	Longnose skate	*
Family Chimaeridae		
Hydrolagus _colliei_	Ratfish	WS
Family Bothidae		
Citharichthys _sordidus_	Pacific sanddab	BDQ
Family Pleuronectidae		
Atheresthes _stomias_	Arrowtooth flounder	*
Reinhardtius _hippoglossoides_	Greenland turbot	WS
Hippoglossus _stenolepus_	Pacific halibut	*
Hippoglossoides _elassodon_	Flathead sole	*
Lyopsetta _exilis_	Slender sole	*
Parophrys _vetulus_	English sole	*
Microstomus _pacificus_	Dover sole	*
Glyptocephalus _zachirus_	Rex sole	*
Limanda _aspera_	Yellowfin sole	BDQ
Platichthys _stellatus_	Starry flounder	*
Lepidopsetta _bilineata_	Rock sole	*
Isopsetta _isolepis_	Butter sole	BDQ
Family Agonidae		
Agonidae	Poacher, unid.	*
Bathyagonis _nigripinnis_	Blackfin poacher	*
Odontopyxis _trispinosa_	Pygmy poacher	BDQ
Asterotheca _alascana_	Grey starsnout	BDQ
Podothecus _acipenserinus_	Sturgeon poacher	*
Family Ammodytidae		
Ammodytes _hexapterus_	Pacific sandlance	*
Family Anoplopomatidae		
Anoplopoma _fimbria_	Blackcod	*
Family Aulorhynchidae		
Aulorhynchus _flavidus_	Tube-snout	WS
Family Bathymasteridae		
Ronquilus _jordani_	Northern ronquil	*
Bathymaster _signatus_	Searcher	BDQ
Family Clupeidae		
Clupea _harengus_ _pallasi_	Pacific herring	*
Family Cottidae		
Cottidae	Sculpin, unid.	*
Icelinus _tenuis_	Spotfin sculpin	WS
Icelinus _filamentosus_	Treadfin sculpin	*
Radulinus _asprellus_	Slim sculpin	*
Clinocottus _acuticeps_	Sharpnose sculpin	WS
Malacocottus _kincaidi_	Blackfin sculpin	*
Triglops _pingeli_	Ribbed sculpin	BDQ
Leptocottus _armatus_	Pacific staghorn sculpin	*
Gilbertidia _sigalutes_	Soft sculpin	WS
Enophrys _bison_	Buffalo sculpin	WS
Dasycottus _setiger_	Spinyhead sculpin	*
Ulca _bolini_	Bigmouth sculpin	*
Icelus _spiniger_	Thorny sculpin	*
Family Embiotocidae		
Cymatogaster _aggregata_	Shiner surfperch	*
Family Gadidae		
Gadidae	Codfish, unid.	WS
Gadus _macrocephalus_	Pacific cod	*
Theragra _chalcogramma_	Walleye pollock	*
Family Gasterosteidae		
Gasterosteus _aculeatus_	Threespine stickleback	*
Family Syngnathidae		
Syngnathus _griseolineatus_	Bay pipefish	*

Table C-1. Continued

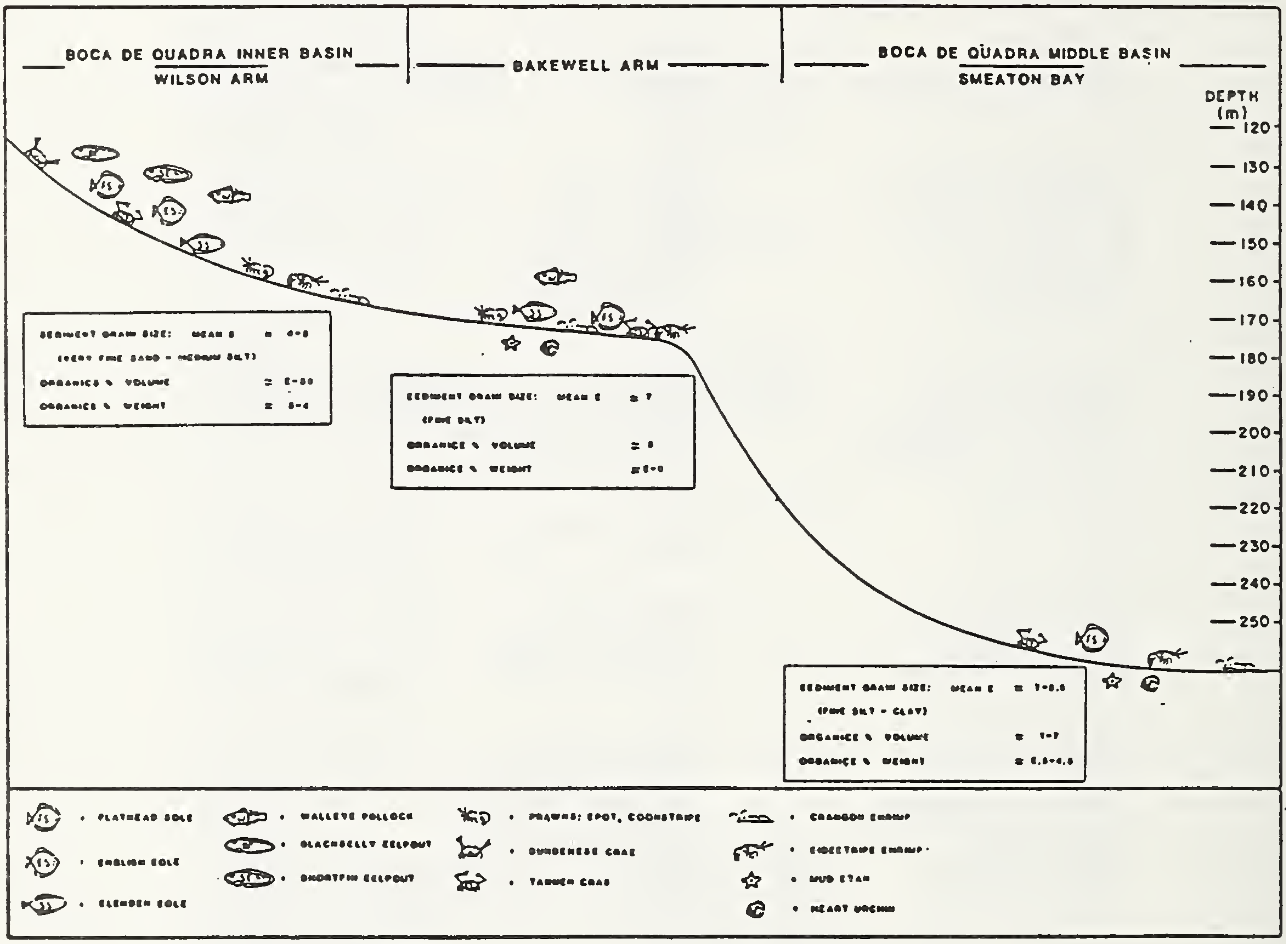
TAXON	COMMON NAME	LOCATION
Family Cyclopteridae		
Liparis fucensis	Slipskin snailfish	WS
Careproctus rastrinus	Pink snailfish	*
Eumicrotremus orbis	Pacific spiny lumpsucker	WS
Family Myctophidae		
Stenobrachius leucopsaurus	Northern lampfish	WS
Family Osmeridae		
Osmeridae	Smelt, unid.	*
Thaleichthys pacificus	Eulachon	*
Hypomesus pretiosus	Surf smelt	*
Family Salmonidae		
Onchorynchus tshawytscha	Chinook salmon	*
Onchorynchus kisutch	Coho salmon	*
Onchorynchus keta	Chum salmon	*
Oncorhyuchus nerka	Sockeye salmon	*
Oncorhyuchus gorbusca	Pink salmon	*
Salvelinus malma	Dolly Varden	*
Salmo gairdneri	Steelhead trout[a]	*
Salmo clarki	Searun cutthroat trout[a]	*
Family Stichaeidae		
Stichaedae, unid.	Prickleback, unid.	WS
Lumpenus sagitta	Pacific snake prickleback	*
Poroclinus rothrocki	Whitebarred prickleback	*
Lumpenella longirostris	Longsnout prickleback	*
Lyconectes aleutensis	Dwarf wrymouth	WS
Family Pholidae		
Pholidae, unid.	Gunnel, unid.	WS
Pholis laeta	Crescent gunnel	*
Family Zoarcidae		
Bothrocara molle	Soft eelpout	*
Aprodon cortezianus	Bigfin eelpout	*
Lycodes brevipes	Shortfin eelpout	*
Lycodapus grossidens	Bigtooth eelpout	WS
Family Scorpaenidae		
Scorpaenidae	Rockfish, unid.	*
Sebastes ciliatus	Dusky rockfish	*
Sebastes pinniger	Canary rockfish	*
Sebastes aleutianus	Rougheye rockfish	WS
Sebastes brevispinus	Silver grey rockfish	WS
Sebates crameri	Dark blotched rockfish	WS
Sebastes flavidus	Yellowtail rockfish	WS
Sebastes maliger	Quillback rockfish	WS
Sebastes ruberrimus	Yelloweye rockfish	WS

Location Key: BDQ - Boca de Quadra
WS - Wilson Arm/Smeaton Bay
* - Both fjords

Note: Although a species may not have been found in one of the fjords, this list does not suggest that it does not occur there. Instead, this difference is probably due to sampling differences and/or the low probability of sampling a less abundant species.

[a] Doherty pers. comm.

SOURCE: VTN 1980, Table 4.3-3; VTN 1981b, Table 4.3-2.



CHARACTERISTIC DEMERSAL FISH OF BOTH FJORDS BY HABITAT AREA

FIGURE C-1

SOURCE: VTN 1983b, Figure 4.3-7

fish abundance within areas of each fjord is reasonable. Within each fjord, a dominant characteristic is the markedly lower abundance of demersal fish as measured by catch per unit effort (Tables 4-4 and 4-5) in the deeper middle basin of Boca de Quadra (0.11 kg/km) and Smeaton Bay (0.58 kg/km) relative to the shallower inner basin of Boca de Quadra (3.12 kg/km) and Wilson Arm (11.57 kg/km).

In the pelagic zone, densities of juvenile herring are similar in each fjord, although the outer fjord areas contain substantially greater densities than the inner fjord areas.

A major, important difference between the fjords is that Smeaton Bay contains, on average, a million (3.5 times) more adult salmon than Boca de Quadra.

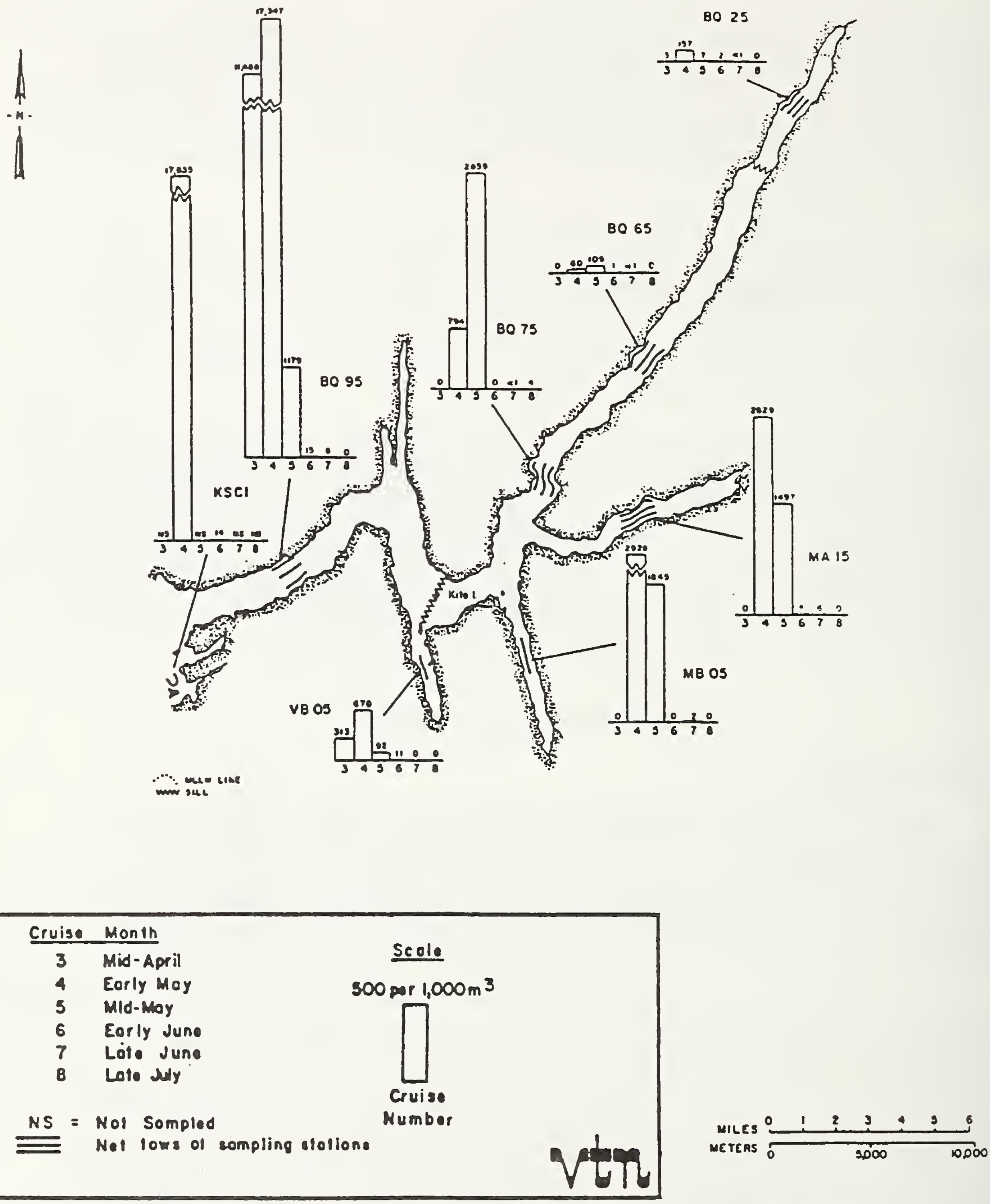
Several locations within Boca de Quadra and Smeaton Bay have been identified as being relatively important. The mouth of Boca de Quadra includes one of the largest herring spawning grounds in southeast Alaska. Larval herring from this spawning ground are most abundant in the outer portion of each fjord. The estuaries and nearshore waters near the head of the fjords are important to juvenile salmon. Also, the shallower areas of each fjord have been shown to support over 20 times more demersal fish biomass than the deeper areas (Tables 4-4 and 4-5).

Description of Resource

Forage Fishes

Pacific Herring (*Clupea harengus pallasi*). Herring, an important forage fish, is also commercially harvested. It is distributed pelagically throughout the North Pacific rim, in the Bering Sea, and along the shores of the Arctic Ocean. A geographically distinct stock occurs in the Ketchikan area, including the Quartz Hill area (VTN 1980, p. 127).

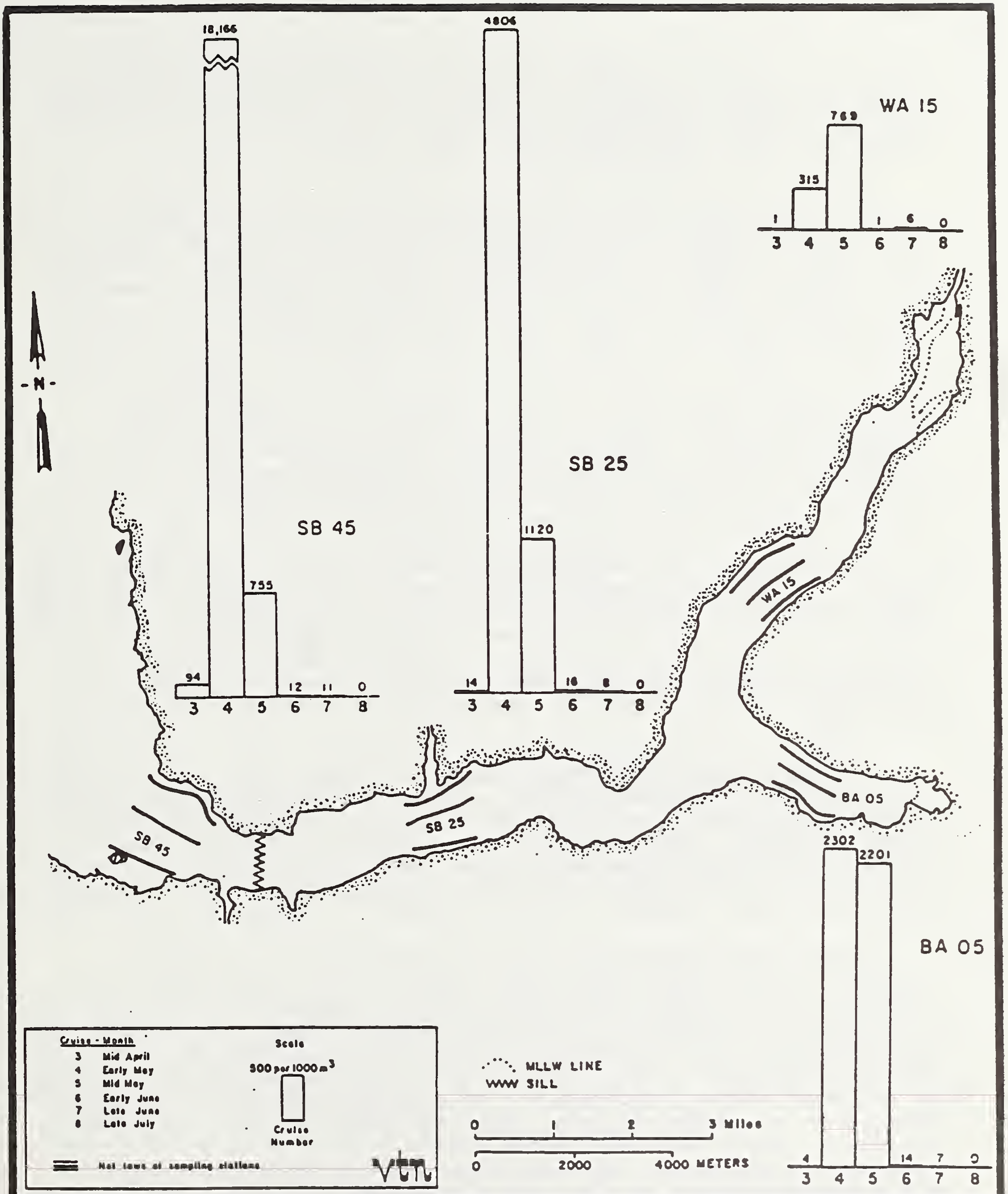
Juvenile herring were the most abundant fish captured in the nearshore habitats of Boca de Quadra (Envirosphere 1984, p. 3-73) and Smeaton Bay (VTN 1981b, Table 4.3-26). In both fjords, abundance of young-of-the-year herring increased from the inner fjord area to the outer fjord area; sidearms also contained numerous small herring (Figures C-2 and C-3). In comparing the two fjords, similar numbers of larval herring were captured in the outer, middle, and inner portions of each fjord. Sampling design was not effective for estimating distribution and abundance of age-1 and older herring; however, Street (1980 *in* Envirosphere 1984, p. 3-73) observed age-1 herring during winter to be most concentrated in the inner basin of Boca de Quadra where the population was estimated to be over a million fish. Herring are also known to overwinter in Smeaton Bay (Larson pers. comm.). Carlson (1980, p. 71) reported that adult herring near Auke Bay, Alaska, inhabited the upper 5-37 m (16-120 ft) during summer, then descended to 52-85 m (170-280 ft) by winter.



AVERAGE DENSITIES OF LARVAL HERRING BOCA DE QUADRA, 1982

FIGURE C-2

SOURCE: VTN 1982f, Figure 3-1



AVERAGE DENSITIES OF LARVAL HERRING IN SMEATON BAY, 1982

FIGURE C-3

SOURCE: VTN 1982f, Figure 3-4

Similarly, herring in Boca de Quadra were found near or resting on the seafloor at depths of 70-90 m (230-300 ft) during winter daylight hours, then rising and dispersing through the water column at night (Blankenbeckler pers. comm.).

One of the largest populations of herring in southeast Alaska spawns near the mouth of Boca de Quadra at Kah Shakes Cove and vicinity during late winter and early spring (VTN 1982c, p. 49). Smaller herring stocks spawn in the inner basin of Boca de Quadra and at Carp Island located near the entrance to Smeaton Bay. However, most herring in the fjords are believed to have originated from Kah Shakes Cove. This hypothesis is supported by the large number of larval herring in the outer portion of the fjords relative to the inner portion (Figure C-2 and C-3). The large number of age-1 herring at the head of Boca de Quadra suggests that the fjord is an important year-round rearing habitat. Extensive data to compare the relative use of the inner and middle basin of Boca de Quadra by older herring is not available, although both basins are probably heavily used by schools of migrating herring (Blankenbeckler pers. comm.).

Major prey of herring in Boca de Quadra and Smeaton Bay are copepods, fish eggs, and pelagic snails (Limacina sp.) (VTN 1982c, pp. J-2 to J-18 and pp. 0-2 to 0-7). Generally, calanoid copepods are the major food item of young-of-the-year and 1-year-old fish. Older herring consume euphausiids, fish eggs, and harpacticoid copepods. During winter, herring generally do not feed. Herring, in turn, are consumed by birds, seals, and sea lions.

Pacific Sandlance (Ammodytes hexapterus). Pacific sandlance is an important forage fish that ranges from southern California to the Bering Sea (Hart 1973, p. 362). It generally inhabits water less than 100 m (330 ft) and, because it lacks a swim bladder, must either actively swim, rest on the bottom, or bury into sand or fine gravel. Sandlance form large pelagic schools during the day, returning to the bottom at night.

During 1981 and 1982, sandlance were one of the most abundant fishes of the nearshore zone of Wilson Arm and inner Boca de Quadra (VTN 1983b, Table 4.3-1). Sandlance are distributed in patches of great abundance. Spawning is estimated to occur from February through May based on catches of larval fish (Envirosphere 1984, Figure 3-18). Spawning probably occurs in areas of strong currents and at depths of 25-100 m (82-330 ft) (Rogers et al. 1980, p. 14). Eggs are demersal and deposited in clusters. Newly hatched larvae remain buried in sand until the yolk sac is absorbed. At that time, larvae become planktonic until metamorphosis to the juvenile stage.

Sandlance feed mainly on calanoid copepods, euphausiids, and larvaceans (VTN 1982f, Tables 3-4 and 3-5). Sandlance are an important food item for fishes, seals, sea lions, and birds in Boca de Quadra and Smeaton Bay.

Other Forage Fishes. Other important forage fishes include smelt (Osmeridae), pricklebacks (Stichaeidae), and eelpouts (Zoarcidae). Abundance of these forage fish varied with year and location of sampling. Smelt were not abundant in Boca de Quadra during 3 years of sampling, but they were abundant in the limited sampling of epi- and mesopelagic waters of Smeaton Bay in 1982 (Envirosphere 1984, p. 3-75). Eelpouts were abundant during 1 year of sampling in Boca de Quadra and were the second most abundant fish in Wilson Arm; relatively few eelpouts were captured in Smeaton Bay. Pricklebacks were abundant throughout Boca de Quadra, but abundance of pricklebacks was low in Wilson Arm relative to Smeaton Bay. Within Boca de Quadra, forage fish were more abundant in the inner basin than in the middle basin.

Pelagic Fishes

Pacific Salmon (*Oncorhynchus* spp.). All five species of salmon (pink [*O. gorbuscha*], chum [*O. keta*], coho [*O. kisutch*], chinook [*O. tshawytscha*], and sockeye salmon [*O. nerka*]) are abundant in Boca de Quadra and Smeaton Bay. River dwelling salmon (coho, chinook, pink, and chum) inhabit streams throughout both fjords, whereas sockeye salmon, which rear in lakes, are found primarily in the Hugh Smith Lake and Bakewell Lake Systems. ADFG is embarking on a 5-year salmon enhancement program and will stock the Bakewell Lake System with 600,000-700,000 sockeye fry per year (Novak pers. comm.).

Tributaries entering Wilson Arm support the largest number of salmon entering the two fjords. An average return (catch and escapement) of salmon to Wilson Arm is 1.4 million salmon (Table C-2). Pink salmon is the most abundant species and comprises approximately 97 percent of the return. Tributaries entering the inner basin of Boca de Quadra support the second largest population of salmon. Average return of salmon to the inner basin is approximately 0.4 million salmon, of which pink salmon comprise 83 percent. Next in abundance to pink salmon in each fjord are chum, sockeye, coho, and chinook salmon, in decreasing order.

A number of streams other than those listed in Table C-2 support salmonids. For example, Humpback Creek (which drains into Mink Bay) contains one of the largest runs of large-size steelhead trout in the Ketchikan area (Doherty pers. comm.). The Hugh Smith Lake system (which drains into the middle of Boca de Quadra basin) supports sizable runs of salmon, steelhead, searun cutthroat trout, and searun Dolly Varden char. The Bakewell Lake system also contains sizable salmonid populations.

Mature chum salmon are the first species to return to the two fjords. The peak escapement of spawning chum occurs in mid-July/early August and is followed by an additional but smaller escapement peak in the Keta and Blossom Rivers during September (VTN 1982b, p. 2; VTN 1983c, p. 2). Next to enter spawning habitats are sockeye salmon in early August, pink salmon

Table C-2. Estimated Average Return (Catch and Escapement) and Escapement (No. of Fish) of Salmon Returning to Several Spawning Streams in Boca de Quadra and Smeaton Bay

SPECIES	KETA RIVER (Inner Basin - Boda de Quadra)		ARONITZ CREEK (Inner Basin - Boca de Quadra)		HUGH SMITH LAKE SYSTEM[a] (Middle Basin - Boca de Quadra)		WILSON RIVER (Wilson Arm)		BLOSSOM RIVER (Wilson Arm)		TUNNEL CREEK (Wilson Arm)	
	RETURN	ESCAPEMENT	RETURN	ESCAPEMENT	RETURN	ESCAPEMENT	RETURN	ESCAPEMENT	RETURN	ESCAPEMENT	RETURN	ESCAPEMENT
Pink	309,670	102,290	2,160	712	ND	5,113	1,063,650	351,000	287,680	94,940	2,560	8,430
Chum	51,110	17,890	690	240	ND	148	4,990	1,750	14,190	4,970	1,640	576
Coho	7,230	1,450	20	ND	ND	1,191	5,250	1,050	14,920	2,980	170	ND
Chinook	3,460	692	ND	ND	ND	--	1,190	240	1,880	370	30	ND
Sockeye	--	--	--	--	ND	13,048	--	--	--	--	--	--

a - Escapement estimates based on average number of salmon passing the weir in 1983 and 1984; Siedelman pers. comm.
ND - No data.
Note - Return and escapement estimates of salmon from other drainages in the fjords are not available.

SOURCE: Envirosphere 1984, Table 3-9 and 3-10.

throughout August, chinook salmon in late August, and coho salmon in mid-October/early November.

The life history of salmon species is outlined in Table C-3. Peak outmigration of pink and chum salmon in both fjords occurs from mid-April to mid-May (VTN 1982b, p. 2). A distinct peak outmigration period has not been observed for chinook, coho, and sockeye salmon. Important rearing habitats include the estuaries at the head of the fjords and the shoreline areas. Estimated residence time in the fjords is 3-5 weeks for juvenile pink salmon and 6 weeks for chum salmon. Chinook, coho, and sockeye salmon are present from late April through August and possibly later.

Feeding habits of juvenile pink and chum salmon, which rear in the fjords for a longer time than other salmon, vary with prey availability. Harpacticoid copepods were most important in late March and April (VTN 1982b, p. 3). Calanoid copepods were important in April. Chironomids and plecopterans were important to chum salmon in June.

Demersal/Semi-Demersal Fishes

Walleye Pollock (*Theragra chalcogramma*). Pollock ranges from central California through the Bering Sea (Hart 1973, p. 229) and is a dominant demersal fish of the continental shelf and upper slope of the Gulf of Alaska (Morris et al. 1983, p. 93). Pollock frequently form large schools at depths of 100-400 m (330-1,320 ft) along the outer continental shelf and slope and in the deepwater straits and embayments of southeastern Alaska.

In Boca de Quadra and Smeaton Bay, pollock is one of the most abundant demersal fishes. Pollock are especially abundant in the inner basin of Boca de Quadra and Bakewell Arm (Envirosphere 1984, p. 3-72). Small pollock (<360 mm) were most abundant in the nearshore zone in 1982 but not in 1981. Distribution of larvae and length data for adults indicate pollock spawn primarily outside the fjord (VTN 1983b, p. 117).

Pollock are opportunistic consumers of both benthic and pelagic organisms such as large amphipods and shrimps, euphausiids, smelt, and other small fish (Morris et al. 1983, p. 95). Pollock, in turn, are important prey for other fishes, birds, and marine mammals.

Flathead Sole (*Hippoglossoides elassodon*). Flathead sole ranges from northern California to the Bering Sea (Hart 1973, p. 612) and is one of the most abundant fishes in the Gulf of Alaska (Ronholt et al. 1978, p. 912; Hitz and Rathjen 1965, p. 13). Greatest concentrations occur in the western and northeastern part of the Gulf and the inside waters of southeastern Alaska.

Table C-3. General Life History Data for the Five Species of Alaskan Salmon

	SPECIES				
	PINK	CHUM	COHO	SOCKEYE	KING
No. of eggs	2000	3000	3500	3700	4800
Spawning season	Mid-June to Oct	July-Nov	July-Dec	June-Nov	Mid-May to mid-Dec
Time in freshwater	several days to several weeks	<1 month	1-2 years	1-4 years	3 mo-2 yr
Out migration of smolts	Feb-April	May-Sept	Feb-mid-July	May-Sept	March-Aug
Length of ocean phase (yrs)	1 1/3	1/2-5	1-2	1/2-4	1-5
Age at maturity (yrs)	2	2-6	2-4	3-7	2-8
Major spawning areas	Intertidal and short streams	River-lake systems	Short coastal streams and intertidal	River-lake systems	Large rivers & tributaries

SOURCE: Morris et al. 1983, p. 70.

In Boca de Quadra and Smeaton Bay, flathead sole are the most abundant flatfish. They are abundant in both shallow and deepwater areas (VTN 1983b, p. 111). Catches of numerous flathead sole larvae indicate spawning in the fjord during March and April. Important nursery/rearing areas include the shallow head of the fjords and side arms. Food items include crustaceans, clams, and worms (Hart 1973, p. 613).

English Sole (Parophrys vetulus). English sole ranges from Baja California to Unimak Island, Alaska, at depths less than 550 m (1,810 ft) (Hart 1973, p. 630). Greatest concentrations occur in waters less than 130 m (430 ft). Hitz and Rathjen (1965, p. 13) reported that English sole were the sixth most abundant fish in the Gulf of Alaska at depths less than 50 m (160 ft).

English sole larvae, juveniles, and adults were abundant relative to other flatfish species in both fjords (VTN 1983b, p. 116). Larval abundance and distribution indicates English sole spawn in the fjords from January through March. Important nursery/rearing grounds are located at the head of the fjords and in the side arms. English sole were most abundant during March. They apparently move to deeper waters during winter (Hart 1973, p. 630). Food of this small-mouthed flounder consists mainly of clams and clam siphons, other small molluscs, polychaetes, small crabs and shrimps, and brittle stars.

Slender Sole (Lyopsetta exilis). Slender sole ranges from Baja California to southeastern Alaska at shallow to moderate depths (<510 m [1,680 ft]) (Hart 1973, p. 626). It was not found to be abundant in the Gulf of Alaska by Ronholt et al. (1978, p. 912) and Hitz and Rathjen (1965, p. 13).

Slender sole was among the three most abundant flatfish species in Boca de Quadra and Smeaton Bay (VTN 1983b, p. 114). Greatest concentrations of sole occurred in shallow areas such as the inner basin of Boca de Quadra, Wilson Arm, and Bakewell Arm. Relatively few sole larvae were encountered. In Puget Sound, sole spawn in April (Hart 1973, p. 626). Little other life history information is available.

Rockfish (Sebastes spp.). Rockfish are an abundant species group found throughout the North Pacific. Greatest concentrations concentrations in the Gulf of Alaska occur along the continental shelf edge and along the upper slope (300-500 m [980-1,640 ft]) (Morris et al. 1983, p. 122), although they are frequently encountered in shallow waters.

In both fjords, rockfish larvae were the third most abundant fish larvae (Envirosphere 1984, p. 3-73). Rockfish bear live young, and it is likely that young are born in the fjords. Few juveniles and adults were captured because the sampling design was not directed to capture rockfish. Dark-blotched rockfish (S. crameri) was the most abundant of the juvenile rockfish; most adult rockfish were quillback rockfish (S. maliger) and yelloweye

rockfish (*S. ruberrimus*). Food of rockfish includes shrimp, other crustaceans, and fishes.

Appendix D

MARINE MAMMAL RESOURCES

Introduction

Marine mammal species expected at least seasonally in the vicinity of Boca de Quadra and Smeaton Bay include five whale species, four porpoise and dolphin species, two seal species, and the sea lion. Only a few of these species have actually been observed in Boca de Quadra and Smeaton Bay. It should not be assumed, however, that a species does not use the area just because it has not been observed; most marine mammal species are highly migratory and observation periods have been brief. Mammal information is poorly documented in the project area. Any species known to occur in the vicinity of Revillagigedo Channel or Behm Canal could potentially enter either Boca de Quadra or Smeaton Bay. For this reason, a number of species known to occur in the vicinity are described even if they have not been directly observed in Boca de Quadra or Smeaton Bay.

All marine mammals are protected to some extent by various legal mechanisms. The Marine Mammal Protection Act of 1972 addresses management of all marine mammals and protects or restricts their harvest. In addition, the gray, humpback, and sei whale are protected and managed under the Endangered Species Act of 1973.

Description of Resource

Seals and Sea Lions

Two seal and one sea lion species may occur in the project vicinity: harbor seal, northern elephant seal, and Steller sea lion.

Harbor Seal. The harbor seal (*Phoca vitulina richardii*) ranges from the Bering Sea southward to Baja California. About 750,000 individuals exist in the North Pacific. The harbor seal tends to frequent nearshore waters and haul out on sandy beaches or on offshore islands and rocks. They have been shown to move considerable distance between haulouts (Pitcher and McAllister 1981, p. 292). Breeding occurs in late June to late July, with pupping/weaning occurring from mid-May to mid-July (DOI 1981, Graphic 11).

Seal haulouts in the vicinity of the project were noted approximately 150 m (0.25 mi) from the Keta River, in several areas of the middle basin, near the head of Wilson Arm, and near the junction of Blakewell and Wilson Arms near Smeaton Bay (VTN 1982g, p. 8; Rescan Environmental Services 1984, p. 73). The number of seals using these haulouts was small. The bimonthly surveys (1981) were brief, but the greatest number of seals (16) was noted in August in the Keta River estuary (VTN 1981a, p. 49). Seals pup all along the shoreline and can be found on ice in the winter. Seals are present year-round in the project area (Wood pers. comm.).

Harbor seal diet varies with location, but fish and cephalopods are generally preferred. Octopus, capelin, walleye pollock, flatfish, and sandlance are all common food in the Kodiak area (DOI 1981, Graphic 11), and it is likely they are important in the project area as well.

Northern Elephant Seal. The northern elephant seal (*Mirounga angustirostris*) population has made a rapid comeback from approximately 100 individuals in 1900 to an estimated 50,000 in the 1970's (DeLong 1978, p. 207). Rookery and breeding areas are located off the coast of California and Baja California, but the nonbreeding distribution extends northward from California to the Gulf of Alaska. Elephant seals would be expected in Alaskan waters from April through June.

Elephant seals are deep divers and may feed well offshore, commonly descending to a depth of at least 180 m (600 ft). They feed on deepwater fish, bottomfish, and squid.

Steller Sea Lion. The Steller sea lion (*Eumetopias jubatus*) has a worldwide population of about 250,000 (Gentry and Withrow 1978, p. 168). Although its range extends from southern California to the Bering Strait, the major concentrations are found in the Gulf of Alaska and the Aleutian and Pribilof Islands. Their distribution includes the project vicinity, and they have been noted in the mouth of Boca de Quadra (Wood pers. comm.).

Breeding occurs from late May to early July. Sea lions have well-defined breeding and pupping areas, although extensive movement of large population segments between rookeries has been observed. For example, Puale Bay, Alaska, which normally has 1,000-3,000 individuals, was censused at 20,000 individuals in 1977 (DOI 1981, Graphic 11). Some migration also occurs, but individual patterns are not well understood.

Sea lions are surface and mid-water feeders (Fiscus et al. 1976, p. 41). Primary prey include fish (pollock, capelin, Pacific cod), crustaceans, and cephalopods.

Porpoise and Dolphins

Four species of porpoise and dolphin potentially occur in the study area vicinity: harbor and Dall porpoise (*Phocoena phocoena* and *Phocoenoides dalli*), the Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and the pilot whale (*Globicephala macrorhynchus*). The pilot whale is generally classified in the same family with porpoises and dolphins. VTN (1982g, p. 14) reported porpoise in the Revillagigedo Channel, but the species was not identified.

Dall Porpoise. The Dall porpoise range extends from southern California to the Bering Sea. Three separate stocks have been postulated (Leatherwood and Reeves 1978, p. 107). Although no population estimates for the northern Pacific have been made, approximately 2,000 are found in the Gulf of Alaska (DOI 1981, Graphic 11). Dall porpoises are often found together with harbor porpoises in the deep fjords along the southern Alaska coast, although they also range far offshore. They have been noted in both Boca de Quadra and Smeaton Bay (Wood pers. comm.). Little is known about their reproductive habits, but they appear to breed and give birth throughout the range. This species depends to some extent on organisms of the deep scattering layer for food, feeding nocturnally on squid, pelagic and deepwater hake, and lanternfish.

Harbor Porpoise. In contrast to the Dall porpoise, the harbor porpoise (*Phocoena phocoena*) frequents primarily sheltered bays, river mouths, and other inshore areas and would be found primarily in waters shallower than 18 m (60 ft) (Leatherwood and Reeves 1978, p. 102). As the harbor porpoise is very timid, it is rarely sighted even in areas where it is fairly common (Leatherwood and Reeves 1978, p. 101).

The highest winter concentration of harbor porpoise in the Pacific probably occurs in Prince William Sound. Hall (1979 *in* Morris et al. 1983, p. 181) estimates winter and summer concentrations of 590 and 946, respectively, for this area. The Gulf of Alaska population numbers approximately 1,000. Population concentrations shift in response to prey, but there appear to be no obvious migrations (Leatherwood and Reeves 1978, p. 102). The Alaskan population moves to inshore areas in spring (Hooks, McCloskey and Associates 1982, p. 138) and more likely would be found in the project area at that time.

Prey species include bottom fish (cod, flounder), herring fry and invertebrates (squid, clams, and crustaceans). A large herring spawning area is located at the mouth of Boca de Quadra, and this may be an attraction for harbor porpoise.

Pacific White-Sided Dolphin. The Pacific white-sided dolphin ranges from Baja California to the Aleutians. It is considered most abundant in the Gulf of Alaska during spring and summer but is occasionally present in fall and winter.

Migrations are poorly documented, although there appear to be seasonal movements northward and possibly offshore in summer. The largest number of sightings has occurred beyond the 200 m (660 ft) isobath. They inhabit the coastal heads of deep canyons and range seaward at least to the edge of the continental shelf (Leatherwood and Reeves 1978, p. 103), although they may sometimes come quite close to shore. An opportunistic feeder, it is known to feed on a variety of fish and squid.

Short-Finned Pilot Whale. The short-finned pilot whale range generally includes both tropical and temperate waters (Reilly 1978). Along the Pacific coast they are most abundant south of Point Conception, California. Their distribution extends northward to the Gulf of Alaska, and they may be expected in the project vicinity. They travel and hunt in highly organized pods, although feeding groups are more loosely organized. Pods may vary from a few to more than 300 individuals, and strong bonds between individuals are well documented.

Life history is not well known, although births appear to peak in August, and the gestation/nursing cycle lasts an average of 40 months. There is some evidence that pilot whales are relatively more abundant inshore during the winter. Their preferred food is squid, and their location tends to correspond to areas where squid are abundant. They are known to take fish if squid are not available.

Whales

At least five whale species are found in the waters in or near the Revillagigedo Channel. Several others are offshore species that would not be expected in Boca de Quadra. The blue whale (*Balaenoptera musculus*), right whale (*Balaena glacialis*), sperm whale (*Physeter macrocephalus*), and giant bottlenose whale (*Berardius bairdii*) are species infrequently sighted or found primarily offshore. They would not be expected in Boca de Quadra and are not discussed further. The Bering Sea beaked whale (*Mesoplodon stejnegeri*) is also only infrequently observed, but a stranding off the coast near Sitka (Rice 1978) indicates they are at least occasionally present along the southeastern Alaska coastline.

Killer Whale. The killer whale (*Orcinus orca*) is considered by many to be the most widely distributed marine mammal. Extensive migrations are indicated but not well understood (Frost and Lowry 1981, p. 829). Their presence is probably related to prey distribution and density (Braham et al. 1982, p. 59). Killer whales prefer shallow areas of the continental shelf and are considered surface feeders (Fiscus et al. 1976, p. 41). They are the most commonly observed whale species in Boca de Quadra and have been observed in both the inner and middle basins in spring and summer (Rescan Environmental Services 1984, p. 73). Adults and juveniles have also been observed in Smeaton Bay, approximately 1 km (0.6 mi) from Behm Canal. Prey species

include squid, fish, marine mammals (dolphins, seals, porpoises), and even seabirds (Nishiwaki 1967, p. 40).

Gray Whale. The gray whale (*Eschrichtius robustus*) occurs only as two geographically isolated stocks in the North Pacific and adjacent Arctic Ocean. It ranges from the western Beaufort Sea southward to Mexico (Hooks, McCloskey and Associates 1982, p. 150). Population estimates vary from 13,600-17,000 individuals, and it appears that populations may be reaching pre-exploitation numbers (Cowles undated, p. 14).

Gray whales usually travel within a few kilometers of shore (Rice and Wolman 1971, p. 127). They are bottom feeders, and like other baleens, complete most of their feeding in summer, storing the excess as blubber. They have been noted to consume over 150 tons of prey and gain 29 percent of their weight during a 4-month feeding period (Cowles undated, p. 14). Little feeding is thought to occur during migration. Amphipods are the favorite food, although other prey may include benthic worms, molluscs, and schooling fish (DOI 1981, Graphic 12). Most of the population feeds in the northern and western Bering Sea during summer. Feeding locations are generally restricted to coincide with areas of high amphipod density, and the area north of St. Lawrence Island is probably a major feeding ground (Cowles undated, p. 15). Recent evidence indicates, however, that subsidiary populations may have shorter migrations and feed at scattered subarctic locations. Although the extent to which they might feed in the vicinity of the project is unknown, presence offshore of the study area would likely be limited to migration.

Humpback Whale. The North Pacific humpback whale (*Megaptera novaeangliae*) population has been reduced from prewhaling estimates of several thousand to an estimated 850-1,400 individuals (Braham et al. 1982, p. 58; Fiscus et al. 1976, p. 41). With an estimated worldwide population of approximately 6,000 (Wolman 1978, p. 53), the humpback is the second rarest of the cosmopolitan whale species. Three reproductively-isolated stocks exist, and all three populations are now increasing. The Gulf of Alaska and southeastern Bering Sea are the two Alaskan centers of concentration (DOI 1982, pp. 111-132). These are frequented from April through December (Fiscus et al. 1976, p. 29). The Bering Sea, Gulf of Alaska, and area south to California are used as summer feeding range. An unconfirmed humpback sighting was made in Boca de Quadra near Mink Bay by VTN (1982g). Nine other sightings were made in 1977 and 1978 in the general vicinity of the project (VTN 1982g).

Like most other baleens, the humpback feeds only in summer, living off its blubber during migration and breeding periods. The humpback is considered a coastal species and a surface feeder (Fiscus et al. 1976, p. 41). Prey species include euphausiids and small fishes such as herring and cod (DOI 1981, Graphic 12). As the mouth of Boca de Quadra is a major herring spawning area, they may possibly be attracted to this area.

Minke Whale. The minke whale (*Balaenoptera acutorostrata*) is the smallest baleen whale in the Northern Hemisphere. It is relatively common, and Frost and Lowry (1981, p. 828) estimate worldwide population at 350,000. It occurs widely in the North Pacific during summer, but winter sightings have been made farther south, mainly between 20 and 25° N Latitude (Mitchell 1978, p. 40). Although no sightings of minke whales have been made in Smeaton Bay or Boca de Quadra, this area is within its range. Minke whales feed primarily on euphausiids and small fish, such as anchovy and sandlance. They tend to concentrate in areas of abundant food and would be expected near Boca de Quadra, a major herring spawning area. Breeding peaks in January and June, with calving peaks in December and June.

Sei Whale. The North Pacific sei whale (*Balenoptera borealis*) population has been reduced from an estimated 40,000-42,000 to approximately 8,600 (Fiscus et al. 1976, p. 41). Three populations (east, west, and central) have been identified, with the eastern population observed to migrate from California in winter to off the Canadian coast in summer. The largest known Alaskan concentration occurs just east of Portlock Bank in summer (Fiscus et al. 1976, p. 27). Sei whales are mainly surface feeders. Principal prey species have been known to include copepods, euphausiids, and fish.

Appendix E

MARINE AND COASTAL BIRD RESOURCES

Description of Resources

Regional Resources

Over 200 species of birds are known to occur along the Gulf of Alaska coast from Prince William Sound to Cape Fairweather (Gusey 1978, p. 26; DOI 1980, Graphic 6). Approximately 100 species of these marine and coastal birds occur regularly in the Gulf of Alaska region including: 39 seabird species; 35 loon, grebe, and waterfowl species; and 28 shorebird species (Sowls et al. 1978). Although seasonal status of some species may differ, loons, grebes, cormorants, some sea ducks, eagles, gulls, and some alcids are year-round residents of the region. Diving ducks, some sea ducks, and one alcid species are chiefly winter residents. Fulmar, shearwaters, storm petrels, some species of geese, dabbling ducks, terns, and some shorebirds and alcids are summer residents. Substantial numbers of nonbreeding diving ducks also occur in summer. Most species of geese and shorebirds migrate through to other nesting areas.

The most abundant breeding seabirds are Leach's and fork-tailed storm petrels, glaucous-winged gull, black legged kittiwake, common murre, horned puffin, and tufted puffin. Among waterfowl and shorebird species, pintail, oldsquaw, white-winged scoter, dunlin, and western sandpiper are the most abundant in the region. Although more than 3 million seabirds nest in the Gulf of Alaska coastal region, they are outnumbered by the influx of nonbreeding southern-hemisphere shearwaters which spend the summer foraging in Alaskan coastal waters.

Habitats

Coastal habitats used by aquatic birds are diverse in southeast Alaska. Seasonal use and aquatic habitat type varies with species. Approximately 87 species use inshore waters (within 5-6 km of shore and all outer coastal points and islands), and 177 species inhabit sandy beaches, mud flats, rocky shores, and reefs of the intertidal zone (Isleib and Kessel 1973). The coastal zone stretching landward of high tide (including river deltas and marshes) is used by many marine and coastal species for nesting, foraging, and wintering.

Principal summer inhabitants of rocky coastlines include cormorants and some gulls and alcids. Beaches are used by shorebirds (especially in migration) and gulls; tidal flats,

river deltas, and marshes are used by waterfowl, shorebirds, and gulls. Most species (excluding shorebirds) forage in nearshore and/or inshore waters adjacent to a variety of habitats. In winter, nearshore (including bay and inlet) waters are occupied by loons, grebes, waterfowl, gulls, and alcids. Inshore waters are used by some eiders, gulls, and alcids.

Sowls et al. (1978) have identified 74 seabird colonies with populations totaling about 1.68 million birds in the southeastern Alaska subregion, which extends from Cross Sound to the Canadian border. The largest concentrations occur on Forrester Island and St. Lazaria Island, units of the Alaska Maritime National Wildlife Refuge, where about 1.1 million and 1 million birds nest, respectively. These areas are on the outer coast southwest and northwest of Ketchikan and considerable distance from Boca de Quadra and Smeaton Bay. The nearest seabird colonies (gulls, murres, and cormorants) are found west of Prince of Wales Island (Figure 1-1). No seabird colonies have been identified in the Boca de Quadra and Smeaton Bay region.

Great numbers of seabirds, shorebirds, and waterfowl migrate along the coast to and from breeding and summering ranges in the Gulf of Alaska, interior Alaska, or Arctic tundra (Bellrose 1976; Arneson 1980; DOI 1984). Seabird migration routes generally follow the outer coast. Shorebirds use more nearshore migration routes, but many fly enormous nonstop distances to staging areas north of southeast Alaska. Shorebirds are known to fly at least 1,500 km (900 mi) nonstop to critical staging areas at Controller Bay, the Copper River delta, and Orca Inlet (DOI 1984; Arneson 1980). Waterfowl use a mixture of coastal and nearshore migration routes which include much of southeast Alaska (Bellrose 1976). The largest breeding concentrations are further north, mainly in tundra zones. Although any number of waterfowl may breed in southeast Alaska, Bellrose (1976) identified significant breeding areas for hooded, red-breasted, and common mergansers only.

Southeast Alaska provides important overwintering habitat for seabirds and waterfowl. Many seabirds (especially gulls and alcids) that breed or summer along the coast or offshore waters move inshore during winter (DOI 1984). Bellrose (1976) identified 18 species of waterfowl overwintering in southeast Alaska (Table E-1). One major known waterfowl/seabird overwintering area is found near Wrangell, Alaska, approximately 160 km (100 mi) north of Ketchikan. Large numbers of overwintering greater scaup and common goldeneye are found near Ketchikan (Bellrose 1976).

Marine and Coastal Birds of Boca de Quadra and Smeaton Bay

Field studies of the Boca de Quadra and Smeaton Bay area were conducted during 1980-82 by VTN. Much of the field survey effort focused on estuaries of the Wilson, Bakewell and Keta Rivers with less emphasis placed on the open water or rocky shore habitat of Boca de Quadra and Smeaton Bay (VTN 1982h, p. 32).

Table E-1. Waterfowl Use in Southeast Alaska (Icy Bay to Prince Rupert, B.C.)

	OVERWINTER	BREED	MIGRATE	GENERIC FOOD ITEMS
Geese & Swans	Trumpeter swan Whistling swan Canada goose		Trumpeter swan Whistling swan Lesser snow goose Canada goose Black brant	Aquatic and marine plants
Dabbling ducks	Green-winged teal Mallard Pintail		American widgeon Green-winged teal Mallard Pintail Northern shoveler	Aquatic plants, seeds, worms, insects, larvae
Bay or diving ducks	Greater scaup		Canvas back Greater scaup Lesser scaup	Plants, insects, crustaceans, shellfish, fishes
Sea ducks	Harlequin duck Oldsquaw Black scoter Surf scoter White-winged scoter Bufflehead Barrow's goldeneye Common goldeneye Hooded merganser Red-breasted merganser Common merganser	Pacific eider King eider Harlequin duck Hooded merganser Red-breasted merganser Common merganser	Pacific eider King eider Harlequin duck Oldsquaw Bufflehead Barrow's goldeneye Common goldeneye Hooded merganser Red-breasted merganser Common merganser	Crustaceans (barnacles, isopods, amphipods, shrimps, crabs), molluscs, echinoderms, fish (herring, salmon eggs, sculpins)
TOTAL	18 species	6 species	23 species	

SOURCE: Bellrose 1976.

The most intensive bird surveys of the area were conducted for bald eagle nesting.

The results of bird sightings made by VTN during 1980-82 field studies and in the three estuaries in Quartz Hill area during 1982 are summarized in Tables E-2 and E-3. The waterbirds that used these estuaries and adjacent waters included six families: loons (Gaviidae), grebes (Podicipedidae), ducks and geese (Anatidae), sandpipers (Scolopacidae), gulls (Laridae), and pelagic birds (Alcidae). Bald eagles were also consistently present and often very common in estuary areas.

Loons and Grebes. Field studies by VTN (1982h) during 1980-82 showed loons and grebes to be seasonally uncommon to absent except during the October/November period (Table E-2). Field data were not specific to estuary areas but rather showed seasonal use for the entire Quartz Hill area (VTN 1982h, p. 43).

Ducks, Geese, and Swans. Waterfowl were observed in Wilson, Bakewell, and Keta estuaries, with greatest numbers in February and March and lowest numbers during June and July.

More waterfowl were observed in Wilson estuary than in the Bakewell or Keta estuaries. Sightings of all waterfowl groups, with the exception of bay ducks, were greatest in the Wilson estuary (Table E-3). Surface ducks (mallard, green-winged teal, pintail, and American widgeon) were also most commonly observed in the Wilson estuary, while a greater number of bay ducks (goldeneye and bufflehead) used Bakewell estuary.

Sea ducks (surf scoters and harlequin ducks) were rarely seen in the Quartz Hill area. Sightings were primarily in the Wilson estuary and Bakewell estuary (Table E-3).

Mergansers were observed throughout the field period and were equally common in both the Wilson and Keta estuaries.

Trumpeter swans were primarily observed in Wilson estuary and were seen in the Bakewell estuary only during February and March (Table E-2).

On a seasonal basis, the greatest number of Canada geese were seen in the Wilson estuary during February and March. During late summer and autumn more Canada geese utilized the Keta estuary.

The only other observations of geese in the Quartz Hill area were 40 brant reported in February in the upper area of Boca de Quadra and 30 snow geese seen in the Keta estuary during May.

Sandpipers, Gulls, and Alcids. No estuary-specific numbers for sandpipers or alcids were available (Table E-3). Sandpipers were never common but were observed in moderate numbers in July and August. Alcids were present in spring/early summer and late summer/autumn (August, October/November) but were never abundant.

Table E-2. Marine and Coastal Birds Observed or Indicated in the Quartz Hill Study Area, 1980, 1981, and 1982

SPECIES		1980	1981	1982
Order: GAVIIFORMES - Loons				
Gavia sp.	Unidentified loon	ob	ob	ob
Gavia immer	Common loon	1 pr	ob	ob
Gavia arctica	Arctic loon			ob
Gavia stellata	Red-throated loon			ob
Order: PODICIPEDIFORMES - Grebes				
Podiceps sp.	Unidentified grebe		ob	ob
Podiceps grisegena	Red-necked grebe		ob	ob
Podiceps auritus	Horned grebe			ob
Aechmophorus occidentalis?	Western grebe			ob
Order: CICONIIFORMES - Herons and Allies				
Ardea herodias	Great blue heron	ob	ob	ob
Order: ANSERIFORMES - Waterfowl				
Olor columbianus?	Whistling swan		ob	
Olor buccinator	Trumpeter swan		ob?	ob
Branta canadensis	Canada goose	ob	ob	ob
Branta bernicla	Brant			ob
Chen caerulescens	Snow goose			ob
Anas platyrhynchos	Mallard	ob	ob	ob
Anas acuta	Pintail	ob	ob	ob
Anas crecca	Green-winged teal		1 pr	ob
Anas clypeata	Northern shoveler		ob	
Anas americana	American widgeon	ob	ob	ob
Aythya marila?	Greater scaup		ob	1 ob
Bucephala sp.	Unidentified goldeneye	1 ob	ob	ob
Bucephala clangula	Common goldeneye		ob	ob
Bucephala islandica	Barrow's goldeneye		ob	ob
Bucephala albeola	Bufflehead		ob	ob
Histrionicus histrionicus	Harlequin duck		ob	ob
Melanitta sp.	Unidentified scoter		ob	ob
Melanitta perspicillata	Surf scoter	ob	ob	ob
Mergus sp.	Unidentified merganser	ob	ob	ob
Mergus merganser	Common merganser	ob	ob	ob
Mergus serrator?	Red-breasted merganser	ob		
Lophodytes cuculletus	Hooded merganser			ob
Order: FALCONIFORMES - Hawks and Allies				
Haliaeetus leucocephalus	Bald eagle	ob	ob	ob
Order: CHARADRIIFORMES - Shorebirds and Allies				
Tringa melanoleucua	Greater yellowlegs	1 pr	1 ob	ob
Tringa flavipes	Lesser yellowlegs		1 ob	ob
Actitis macularia	Spotted sandpiper	ob	ob	ob
Phalaropus lobatus	Northern phalarope		ob	
Limnodromus griseus?	Short-billed dowitcher	ob		

Key

ob = observed more than once
pr = pair
? = tentative
1 = only observed on one occasion

SOURCE: VTN 1982h.

Table E-3. Summary of Seasonal Bird Sightings by Species Group in Wilson Arm, Bakewell Arm, and Boca de Quadra, 1982

SPECIES GROUPS	FEBRUARY			MARCH			JUNE		
	Wilson[a,f]	Bake[b,f]	Keta[c]	Wilson[f]	Bake[f]	Keta	Wilson[f]	Bake[f]	Keta
Loons[g]		-----2-----			-----1-----			-----0-----	
Grebes[g]		-----0-----			-----0-----			-----0-----	
Swans	22	13	0	7-14	2	0	0	0	0
Canada geese	120-150	0	~80	~100	~20	~55	0	0	3
Surface ducks	~120	~35	30-40	~75	~35	~25	~25	0	~15
Bay ducks	60-95	~30	35-45	55-95	70	45-60	0	0	5-10
Sea ducks	0	0	0	5-10	0	0	5-10	0	5-10
Mergansers	~15	5-10	25-30	~20	~10	20-40	~25	0	10-15
Sandpipers[g]		-----0-----			-----0-----			-----2-----	
Gulls	~5	~5	5-15	800-1000	~10	~20	~10	~5	~5
Alcids[g]		-----0-----			-----10-20-----			-----~30-----	

SPECIES GROUPS	JULY[d]			AUGUST			OCT/NOV		
	Wilson[f]	Bake[f]	Keta	Wilson[f]	Bake[f]	Keta	Wilson[f]	Bake[f]	Keta
Loons[g]		-----1-----			-----5-----			-----65-75-----	
Grebes[g]		-----0-----			-----1-----			-----30-35-----	
Swans	0	0	0	0	0	0	0	0[e]	0
Canada geese	0	0	0	10-15	0	20-30	~20	~60	~50
Surface ducks	10-15	0	0	45	20-25	0	~70	~60	~70
Bay ducks	0	0	0	1	0	0	~20	~115	25-30
Sea ducks	0	0	0	~25	~20	~5	3	1	2
Mergansers	~30	0	~5	25-30	0	~5	5	10	20
Sandpipers[g]		-----~25-----			-----~25-----			-----1-----	
Gulls	~100	~10	~50	~200	20-20	~225	50	15-20	~100
Alcids[g]		-----0-----			-----10-15-----			-----45-55-----	

a Wilson estuary including Wilson Arm.
b Bakewell estuary including Bakewell Arm.
c Keta estuary including upper Boca de Quadra.
d Observations coincidental with vegetation studies; numbers not comparable to other months.
e Ten to twelve swans were observed in Bakewell Lake area on 10/30 and 10/31.
f Some birds believed to use both Bakewell and Wilson estuaries.
g Monthly totals for entire Quartz Hill area only; no number specific to estuaries.

SOURCE: VTN 1982h

Gulls were present throughout the year and most common in the Wilson estuary. Larger numbers observed in the Wilson estuary in March were coincident with a smelt spawning run in the Wilson and Blossom Rivers; a second, lower peak in numbers occurred in August in conjunction with salmon spawning. During August, high numbers of gulls also were seen feeding on large herring schools in the middle of Boca de Quadra near the Marten Arm.

The potential exists for large numbers of birds to overwinter in Smeaton Bay and Boca de Quadra: abundant food is present; known major overwintering areas are nearby in Wrangell and Ketchikan; both areas lie along a major waterfowl migration route; and estuaries, such as the Wilson and Keta estuaries, are highly productive bird habitats. For these reasons, Boca de Quadra and Smeaton Bay are expected to be prime bird habitat. VTN (1982h) reported only low bird numbers, including single bird observations for a given species. Explanations for the unexpected low numbers include: 1) overwintering birds were missed because of limited winter field time; 2) field investigations concentrated on the estuary and perhaps overlooked birds in open water further down the fjord; 3) birds, while demonstrating regional fidelity, may exhibit a more facultative habitat selection process; or 4) habitat quality is more apparent than real.

Endangered or Threatened and Sensitive Marine or Coastal Bird Species

No endangered or threatened marine or coastal bird species are known to inhabit Boca de Quadra. Sensitive species of potential concern include the peregrine falcon (*Falco peregrinus*) and the bald eagle (*Haliaeetus leucocephalus*). The U. S. Fish and Wildlife Service reported that peregrines are not likely to be present in the project area (Envirosphere 1984).

Bald eagles were present in the area throughout the year but showed large seasonal fluctuations, probably related to food availability. In general, numbers were low during winter months, gradually increasing through spring to a maximum in August (in conjunction with salmon spawning) and then decreased during autumn to low winter levels. This seasonal pattern was similar in both the Smeaton Bay system and the upper Boca de Quadra-Keta River system.

One exception to this general trend was that during March smelt runs in the Wilson and Blossom Rivers, eagle populations increased dramatically in the Wilson estuary. Approximately 90 eagles were observed in the Wilson estuary while at the same time only four individuals were seen in the Keta estuary (VTN 1982h, p. 65).

Bald eagle nesting surveys were carried out by VTN in the Quartz Hill non-wilderness area. A total of 39 nest trees were located during 1982. Twenty-nine trees occurred along Smeaton Bay and in the Wilson Arm estuary and Blossom River. The remaining 10 were located along Boca de Quadra and in the Keta River estuary (VTN 1982h, p. 60).

The fact that more eagles nested and were observed utilizing the Wilson estuary than upper Boca de Quadra and the Keta estuary is probably in response to the large prey base. Populations of salmon and smelt, two fish species known to be utilized by bald eagles, are greater in the Smeaton Bay area than in Boca de Quadra.